LAWNS, KITCHENS, COMPOST

GARBAGE

The Practical Journal for the Environment

JULY/AUGUST 90

$4.95 CANADA **$3.95**

Fragile. Handle

When the Party's Over

We've just completed the twentieth anniversary of the original Earth Day. People around the country celebrated the environment and, once again, strengthened their resolve to defend it. Earth Day was a needed call for dramatic changes in our lifestyles, and for greater dependence on a public that takes the time to make a difference. But in order to manage problems that confront us every day — such as our solid waste — we all must make Earth Day a commitment every day for many future generations.

An Environment Under Siege

Across the country, illegally-dumped trash litters the American countryside. Uncontrolled air and water contamination force outdated landfills to close. Garbage barges are tugged from one port to the next with nowhere to go, and medical wastes routinely wash up along our beaches. While responsive new technologies are blockaded by strident special interests, today's trash crisis threatens to leave an enduring fingerprint of a society of convenience and excess.

Each person in America creates and discards more than four pounds of trash every day, 365 days a year. That's almost a ton of waste every year — adding up to over 160 million annual tons nationwide. It's a number that is growing.

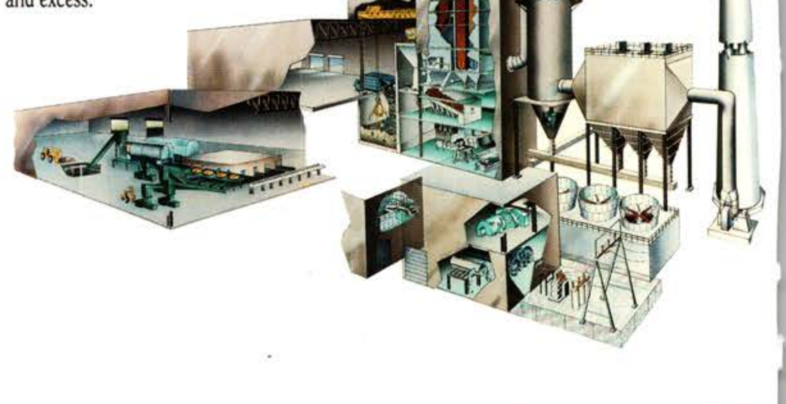
Where will all this trash go in the future? There is no room, or reason, left for outdated landfills or archaic incinerators. We must find safer alternatives.

Lighten Up the Load

Over the last twenty years, America's waste stream has changed dramatically. More and more packaging has found its way into our trash while the amount of organic materials has decreased. A first step in confronting our trash crisis is to change our consumptive habits and reduce the amount of packaging we require. Another is a close review of our household and toxic wastes, better alternatives to their production and use, and better disposal methods. We need to send a message to American manufacturing and business that undesirable materials, such as certain inks, plastics and bi-metals, are adding to our disposal problems, and that developing more practical alternatives will help protect the environment.

Great Recovery

Recycling is not a new idea. Turning trash into new products is as sound a concept as



with care.

ever and offers a number of advantages:

- It reduces the amount of trash going to landfills
- It gives reusable material a second life
- It saves the energy and natural resources needed to manufacture new items
- It avoids costly disposal and generates new revenues.

Recycling is also not the total solution. It needs stable end-markets and efficient collection systems. And it needs complementary technologies to handle trash that will not, or can not, be recycled.

Trash to Energy: Catching the Heat

Materials that have high recovery potential for re-marketing are glass, metals, and composted leaves and grass. Other materials, comprising the vast majority of our municipal wastes, can also be recovered through thermal recycling — turning flammable waste into steam and electricity.

Recycling/trash-to-energy facilities reduce the volume of such waste dramatically, to less than 10% of the volume of unprocessed trash, and consistently meet high regulatory standards for safe disposal. It's a technology that has efficiently operated in this country since the early 70s, and one that can shoulder a major part of our disposal needs well into the 21st century.

Leading by Example

Wheelabrator Technologies is the leading U.S. developer and operator of municipal trash-to-energy and other recycling systems. We provide the largest and most cost-effective operating capacity for non-landfilled waste in the country today.

Since 1975, Wheelabrator's facilities have processed 25 million tons of municipal waste into billions of kilowatt-hours of electricity. In addition to energy, these systems have reclaimed and marketed hundreds of thousands of tons of reusable metals and have pioneered significant new research for beneficial uses of ash residue.

Wheelabrator has dedicated more than 15 years to developing the cleanest available resource recovery system. High-temperature, high-pressure furnace and boiler designs are combined with advanced emissions control devices. Sophisticated computers monitor and maintain all critical operations, and highly-trained operators oversee each facility's daily operations.

Team Play

Underscoring this commitment to providing the latest in municipal solid waste technology, Wheelabrator also provides systems for front-end processing, materials recovery and yard waste composting as part of its innovative Recycle First™ program. Through Recycle First™, we help communities set up and maintain their own customized resource recovery programs.

These integrated systems provide a great opportunity for communities to derive a maximum return on marketable recyclables and reusable materials.

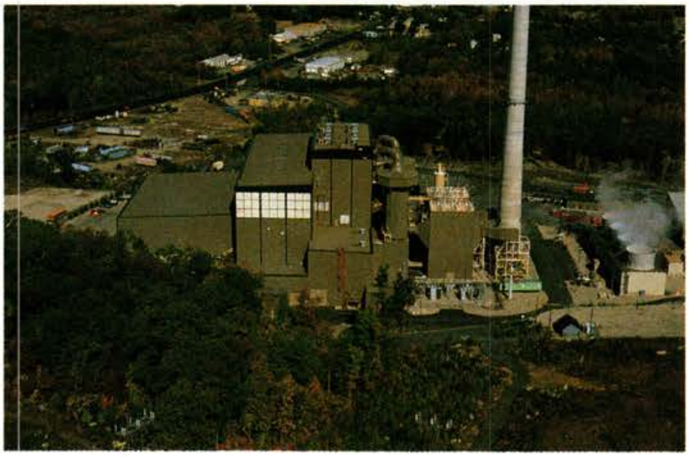
More important, they afford communities an active and efficient role in preserving local environments and public interests.

Partners in Time

We're beginning to make careful choices on how to best handle our trash problems. They're fragile choices, ones that will influence not only how we live today, but how future generations will live as well. They're choices that demand the benefits of experience, technology, leadership, and environmental commitment.

For hundreds of America's towns and cities, waste reduction and the recycling of trash into new materials and energy were once just innovative ideas. Today they are inspiring new solutions. For the rest of our communities, integrated waste management programs promise a safer and more resourceful future, and ensure that Earth Day will be celebrated every day.

We are dedicated to protecting our environment. At some of our facilities, we are working in conjunction with local environmental groups to create or maintain public wildlife sanctuaries.



Over six million Americans in hundreds of towns and cities send their trash to Wheelabrator's plants. This one, in Millbury, Massachusetts, serves 36 communities in the central Massachusetts region.

Wheelabrator's recycling/trash-to-energy process forms the basis for integrated waste management programs in hundreds of U.S. communities.

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We've cleaned up more towns than Wyatt Earp.

The Dodge City Protection Association, led by Wyatt Earp (seated second from left).

This may come as a shock, but the average American home is loaded with hazardous wastes.

The fact is, a lot of that seemingly harmless stuff we've all got lying around the garage or the basement could be incredibly dangerous.

Like the old jars of paint from the kids' model airplane years. The pesticides from some long-forgotten experiment in home gardening. And the brake fluid and motor oil from the days when do-it-yourself seemed like a good idea.

The memories may fade away, but the hazardous chemicals won't.

However, in city-after-progressive-city, people are waking up to the fact that we can't continue to treat our homes like hazardous waste dumps, and we can't continue to throw toxic chemicals out with the rest of the garbage.

In hundreds of cases, Laidlaw Environmental Services has been called in to help communities manage a series of Household Hazardous Waste Collection Days.

Which makes a lot of sense, because Laidlaw Environmental Services is one of the nation's leading companies in the management, movement, treatment and disposal of chemical wastes. And one of the leading consultants in helping people clean up their cities.

So, if you'd like to know more about establishing a household cleanup program for your community, give us a call at Laidlaw Environmental Services today.

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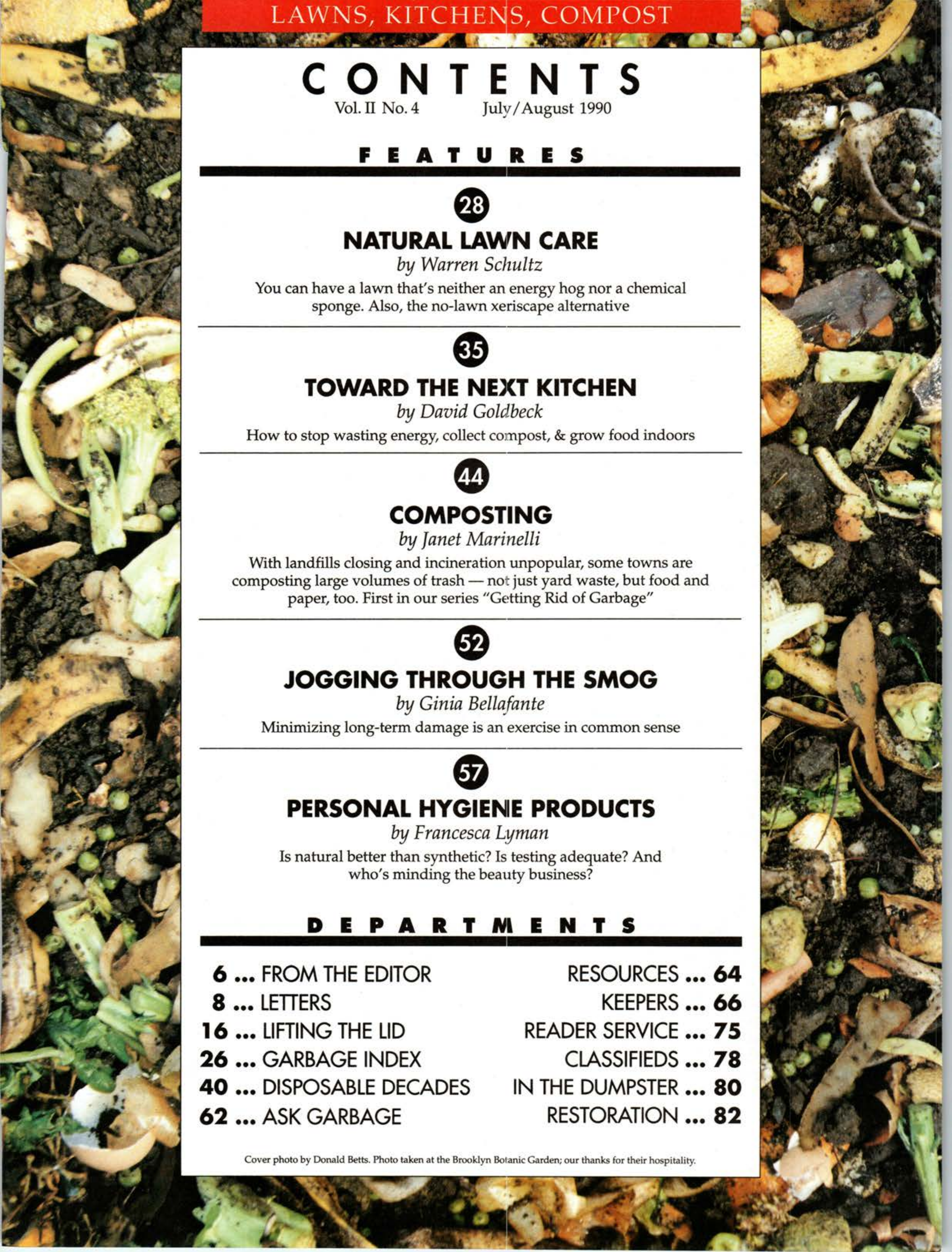

LAWNS, KITCHENS, COMPOST

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FROM THE EDITOR

Remember the "Saturday Night Live" routine where the regulars were cavemen who'd just discovered fire, and Steve Martin stands up and breaks into an involved, passionate, stirring monologue wherein he asks, "Could this be the dawn of civilization?" and, gazing heavenward, suddenly turns to face the audience and blurts, "Naaah..."?

That's how I feel about environmental awareness lately. Some days I'm sure that I'm witness to a monumental change. I'm watching a snowball roll down a hill, getting bigger and gaining momentum; the snowball is awareness and concern, made from the blizzard of information suddenly available and the offhand comments about rainforests and garbage by celebrities, politicians, schoolkids. It's a historic moment in the social evolution of man!

Then I'll be at a shopping mall and see a store selling nothing but day-glo T-shirts with environmental slogans and I think, naaah, it's just a fad and it's going to end, even go out of style, and in the meantime we're all barking up the wrong tree, talking about paper vs. plastic when the real answer is less consumption, not only of the packaging but of the product inside.

The truth, I'm sure, must be somewhere in between. Some days we take one step forward and two steps back. Some days the guy with a cornbelt agenda is going to have the floor, and he's going to do his darndest to convince people desperate for solutions but resistant to change that adding cornstarch to plastic bags is going to save the planet. Some days we're going to be so focussed on collecting garbage for recycling, we'll overlook the lack of a market for it. *But at least the environment has our attention.*

In our first anniversary issue of

GARBAGE

The History of Garbage

Backyard Restoration

Getting Rid of Garbage: The Sanitary Landfill

Environmental Investing

The Corporate Environment

I read in the New York *Times* magazine about the Poppers, husband and wife scholars who have proposed turning parts of the stricken Midwest into public lands. The plan calls for "retiring" non-productive, agriculturally poor land forever, giving it back to the prairie. They'd call it Buffalo Commons.

The idea is radical. Although their scheme is pragmatic in the long haul, it strikes one as almost anti-American: anti-private, anti-progress, anti-productive-at-all-costs. Yet the Poppers are taken seriously. They are in demand as speakers, not only in environmental circles but also in the economically depressed (and resistant) areas that would become Buffalo Commons.

I was awestruck that their proposal had made it this far. The *Times* article, typically, reported in conservative style, dutifully quoting opponents, describing the cheese Danish lying on a textbook in the Poppers' active kitchen. But, for me, this supposed profile of a couple of scholarly kooks was really about a view of land akin to that of Amerind natives. What a milestone change in attitude! What could lie ahead?

Just as the *Times* could not present their profile as "evidence of a radical change in the fabric of American attitudes," we don't present articles in **GARBAGE** as philosophical debates. For now, it is more constructive to talk about politicians' response to the Poppers' proposal. For now, we'll advise that lawns be cut higher and weeds be attacked with less zeal and fewer chemicals. But as you read the issue, I hope you'll muse (as I did) on the underlying themes.

Perhaps, when you're reading "Lawn Care," it will occur to you that there's something strange about our longstanding insistence on clearing away bioregional beauty to plant non-indigenous grasses that demand excessive watering and fussing. Maybe "Toward the Next Kitchen" will have you reconsidering the era of plenty that made us abandon entirely root cellars and pantries for the electric refrigerator. Read "Composting," and you may find yourself wondering how so obvious a solution — letting organic waste rot — got lost in the landfill/incinerator shuffle. "Jogging through the Smog" might leave you questioning modern assumptions about "quality of life," when not only do we have to take time out to run nowhere fast to make up for our sedentary lifestyles, but now we have to worry about whether America's "spacious skies" are fit to breathe ... so sad even to consider.

Patricia Poore

Editor

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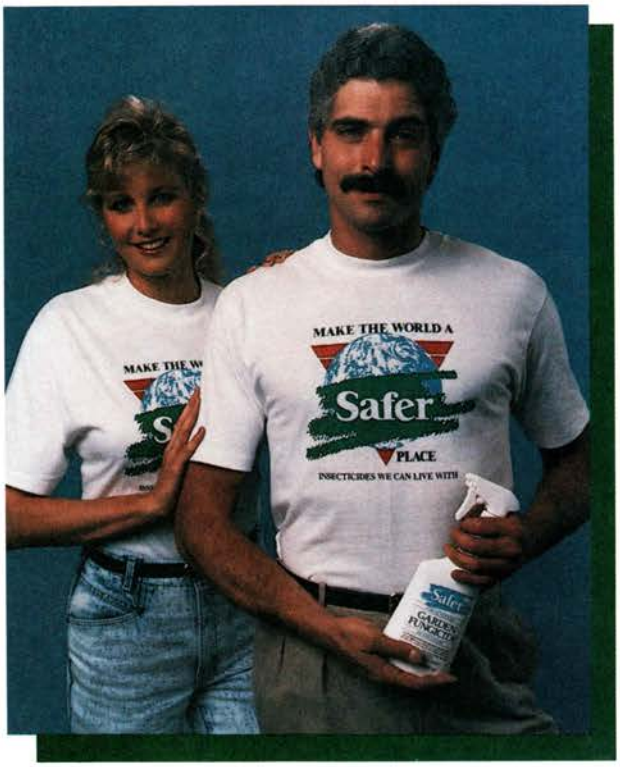
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RECYCLING PAPER

I was slightly disturbed by the article "Recycling at **GARBAGE**" [March/April]. Businesses are designed to produce a product or service and to make a profit, so it seems reasonable to expect them to pay the costs of producing their product or service. Businesses are responsible for bearing the cost of procurement of goods and raw materials — why not also disposal? I would not have expected **GARBAGE** to take the position of surprise and disgust evident in [the statement] "We were on our own." What about personal and corporate responsibility?

The "city" can't magically make garbage, sewage, motor oil, white paper, etc., go away. The general public and the business public must take some responsibility for the garbage they produce.

Naomi Schussler
Allston, Mass.

Agreed! Businesses should be responsible for their trash — which is why we instituted a paper-collection program, bought our own bins, put big hampers in the cellar, and made 35 phone calls until we found a hauler/recycler willing to pick up our relatively small loads. "We were on our own" refers to the current dearth of city-wide programs.

Certainly, we can't build our own repulping mill. Making recycling work is going to have to be a cooperative effort.

— The Editors

I was pleased to note that you go to some pains to point out that environmental protection often involves a host of complex and not easily solvable problems. **GARBAGE** is, indeed, a practical journal for the environment.

In the Congress, my colleagues and I work on lots of legislative initiatives dealing with clean air and other large and complex national and global environmental concerns. But there is also a host of things which you and I can do on the local level. I'm happy to see that each issue of your magazine features several such ideas.

I was particularly interested in the article in your March/April issue on office recycling. I sponsored a congressional resolution last year which resulted in our first pilot project to recycle the Senate's paper products. The latter, I can assure you, is most voluminous. The project is working, and should be expanded to the whole Senate this summer.

Rudy Boschwitz
United States Senator
Minnesota

FLY PREDATORS

We were disappointed at not being included in "Combatting Household Pests without Chemical Warfare" [March/April]. Our Fly Predators, or "beneficial insects," provide a biologically safe, long-term method of fly control by interrupting the reproductive cycle of the pest fly.

(continued)

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Patricia Spalding
Spalding Laboratories
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PLANTS INDOORS

Not everyone is in agreement that plants can effectively remove indoor air pollutants, especially formaldehyde ["Plants for Healthier Homes," March/April]. NASA's experiments used a given quantity of formaldehyde in a test chamber. The formaldehyde found in houses generally comes from a continually outgassing source such as particleboard, which can release the gas for many years. When researchers at Ball State University performed experiments similar to NASA's with a continually outgassing source, they concluded that "spider plants are ineffective in controlling formaldehyde in residential environments." This is because when the plant removes some formaldehyde, the source releases more to make up for the slight reduction. Also, house plants raise the humidity indoors, and formaldehyde outgasses faster at higher humidity levels.

John Bower
Author, *The Healthy House*
Unionville, Ind.

As I noted in the article, while NASA's research shows that spider plants do remove formaldehyde, it also shows they are not as effective as some other plants — and I noted that there's disagreement on the issue. The point you raised about humidity is an important one, though: Excessive humidity creates health problems (mold, etc.) and house problems (moist insulation, peeling paint) in tight houses. Indoor gardeners have to monitor interior humidity levels. In any case, as I also mentioned in the article, the future of using plants as air filters probably lies in enclosed systems removed from possible sources of pollution, like Bill Wolverton's Florida room, into which stale air is routed, cleaned, then recirculated throughout the house.

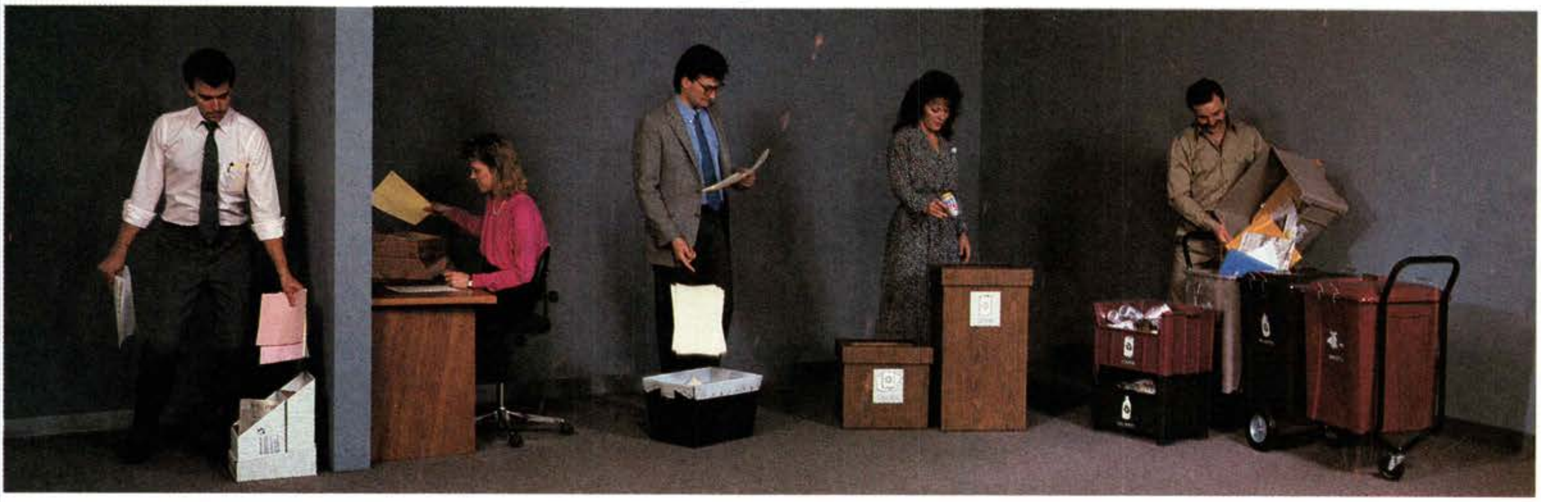
— *Janet Marinelli*

THE TOILET ISSUE

Rocky Mountain Institute commends you on your article promoting the use of state-of-the-art technology in toilets, showerheads, and faucet aerators ["Toilets: Low Flush/No Flush," Jan/Feb]. These devices typically save 35 percent on indoor water use. However, your reference to an RMI study in your article should have read, "One RMI study showed that retro-fitting Denver with water-efficient faucets,

(continued)

Office Recycling From Desk to Dock.



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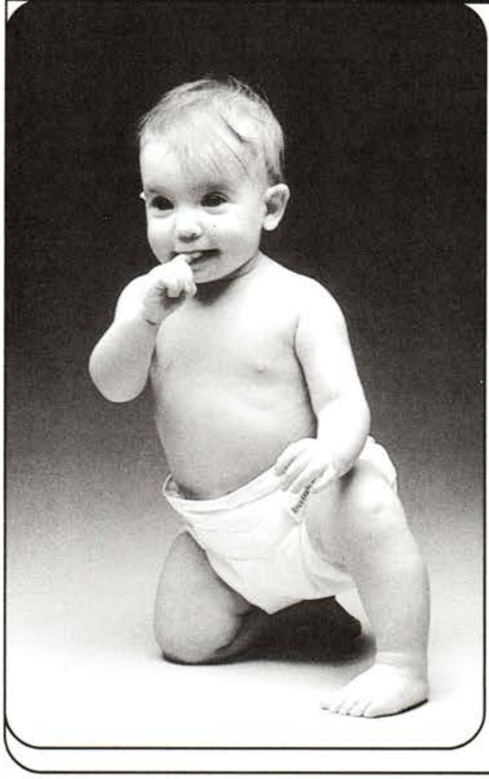

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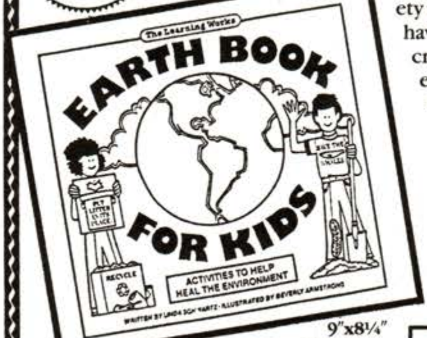
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showerheads, and toilets, *as well as implementing more efficient outdoor watering methods*, would save as much water as would be provided by the proposed $1 billion Two Forks dam — at 20 percent [not 80 percent] of the cost." Anyone wanting a copy of this report, or more information regarding Rocky Mountain Institute's Water Program, can write to: Water Program, Rocky Mountain Institute, 1739 Snowmass Creek Road, Snowmass, Colo. 81654.

KATHLEEN MENKE
WATER RESEARCH ASSISTANT, RMI

CLINICAL ECOLOGY

Thank you for your excellent article about environmental illness/multiple chemical sensitivities ["Clinical Ecology," March/April]. This illness needs attention, not only for the sake of sufferers, but for the sake of everyone who is exposed to the same toxic pollutants. For them it may be only a matter of time before they acquire the condition — or realize that they already have it.

The problem is enormous and complex. But a few answers exist: Do not use scented products; buy plant-based rather than petroleum-based products; support legislation to reduce toxics use by manufacturers.

LYNN LAWSON
CHAIR, PUBLIC RELATIONS,
HUMAN ECOLOGY ACTION LEAGUE
ATLANTA, GA.

I enjoyed your article on clinical ecology [March/April], but you omitted one important reference. We just published *Tired or Toxic?*, which is fully referenced, and gives the entire biochemical explanation and mechanisms for chemical sensitivity. It also spells out the treatment.

SHERRY A. ROGERS, M.D., F.A.C.A.I.
SYRACUSE, N.Y.

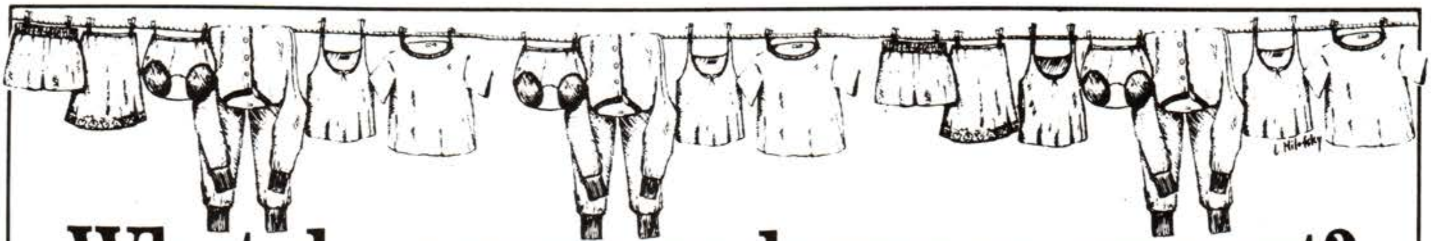
Tired or Toxic? *is $20.95 ppd. from Prestige Publishing, Box 3161, 3502 Brewerton Rd., Syracuse, NY 13220.*

WHO'S THE TOXIC TERRORIST?

I am disappointed that you are turning to people like Elizabeth Whelan to define terms for you ["Garbage Dictionary," March/April]. The people who cloud the issues are people like Dr. Whelan and her group, American Council on Science and Health. (The ACSH is hardly an unbiased source. Their major source of funding is the chemical industry.) Whelan's term "toxic terrorist" is an example of her distortion of the issues. The ones who are real "toxic terrorists" are the ones who are producing these toxins.

SUSAN NUNN
CORSICA, PENN.

Editors Note: Photos for the story "Recycled Paper, Exploding the Myths" (May/June), were provided courtesy of Cross Pointe Paper Corp.



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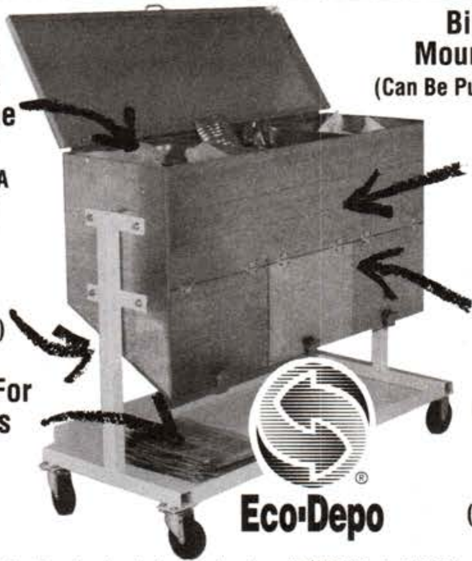

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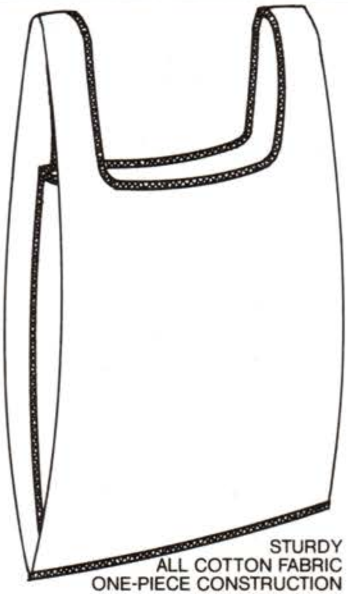

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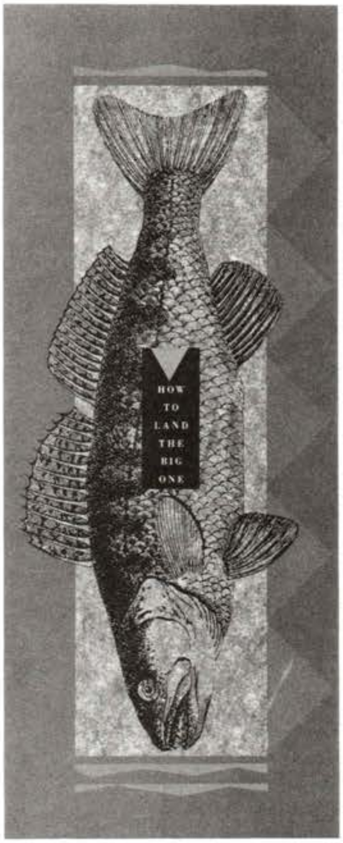

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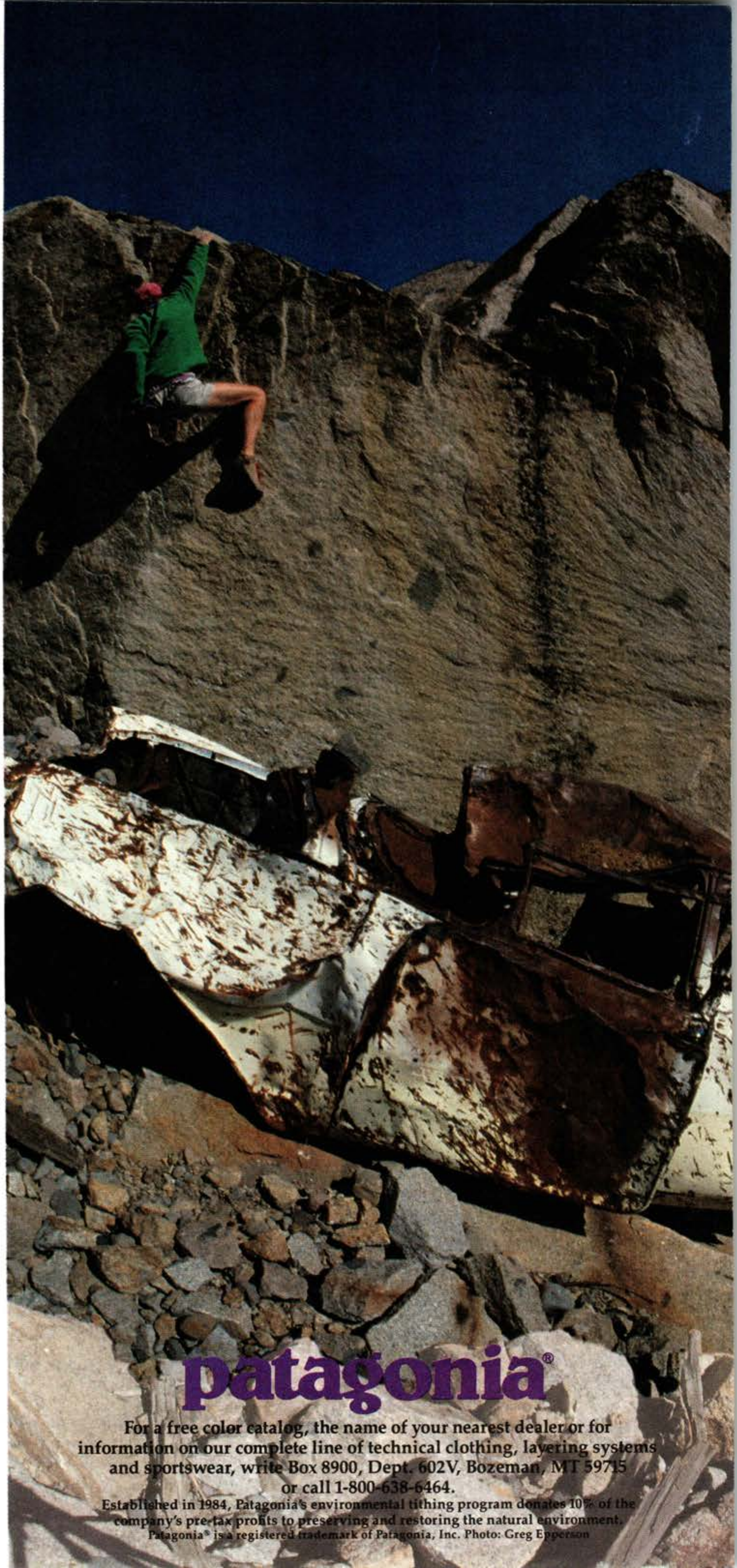

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PROFILE

Nancy Holt: Creating an Industrial Stonehenge

The artist atop Sky Mound, framed by methane wellheads and lower Manhattan: "Contemporary art includes landfills."

BILL BREEN

Holding ten million tons of detritus from the town of Kearny, the 57-acre landfill is just one more blister in this New Jersey landscape of power lines, smokestacks, and refinery towers. But to sculptor Nancy Holt, it is the stuff of art.

Where others see a 110-foot mountain of blight, Nancy envisions a flat-topped pyramid covered with grassy hillocks, an array of spinning wind indicators, and flares spewing from a subsurface methane-recovery system. Retired landfills have been turned into golf courses and amusement parks, but never into works of art. Yet that's what the artist and her team of landscape architects will have accomplished by the spring of 1992, when the transformation of the Kearny dump into "Sky Mound" is completed.

Scrambling across the landfill's rutted, weedy top, Nancy Holt describes a kind of Stonehenge of the industrial age, a naked-eye observatory dotted with steel structures (part of the methane-recovery system) that align with the sun, the moon, and major stars on important celestial events. Like giant croquet wickets, arched methane wellheads will align with the extreme positions of the lunar cycle. Eight gravel paths will bisect eight smaller mounds to trace the passage of the stars Sirius and Vega through the night sky. The landfill's summit offers sweeping views, unimpeded by buildings, that are rare for the New York metropolitan area. "Sky Mound brings the sky down to Earth," sighs the artist.

Who is this woman? Nancy Holt began her art career in the late 1960s with sculpture shows in New York City galleries. But she disliked the emphasis on the commerce of art, the purchasing and collecting of objects. One day found her in the Utah desert, creating immense earth formations. Even these first outdoor works evoked early Celtic monuments and ancient tombs. Since the early '80s, Nancy's work has crossed art with engineering as she created sculptures within the framework of heating, electrical, and water-drainage systems. Here in New Jersey, too, her art will be functional: The site will serve both as wildlife sanctuary and camouflage for the methane-recovery system.

At this point, engineers are sealing the uppermost crown of the mound with a durable, synthetic-rubber liner. Then, 18 inches of topsoil will go over the mound. Already, the commission in charge is fielding inquiries on this experimental capping procedure, especially from municipalities that lack clay, traditionally used for sealing landfills.

Landscaping will include a large pond ringed by oxeye daisies and sulfur cosmos. Swaths of drought- and wind-tolerant wildflowers — lance-leaved coreopsis, black-eyed susans — on the landfill's slopes will provide cover for marsh hawks, raccoons, and rabbits. Methane produced by the decaying garbage will be sold to the

GARBAGE DICTIONARY

crab scrap, *noun.* Compostable crab parts. As landfills bulge and disposal costs soar, those communities burdened with unusual garbage — thousands of tons of crab scrap, fish scrap, potato culls — are digging for disposal alternatives. Of necessity, new methods are being developed for composting animal and vegetable garbage that decomposes too slowly to be included in the average compost heap. (Gradual decomposition causes odor, breeds maggots, and attracts scavengers.)

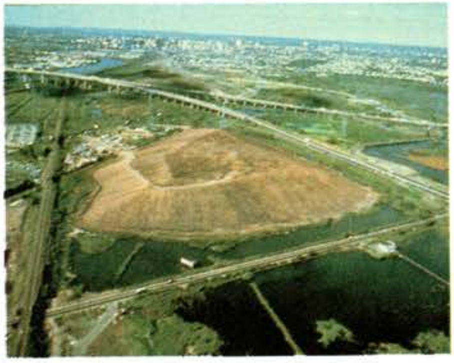
William Brinton, president of Woods End Research Laboratory in Maine, found that adding cypress bark and other wood wastes could speed decomposition and turn Florida's annual yield of 3,000 tons of crab scrap into compost that farmers and gardeners alike buy to use as fertilizer — nurseries pay as much as $4 for 40 pounds.

Mixing tons of dead chickens with manure and sawdust works, too. And Mr. Brinton is currently crafting a recipe that blends Nova Scotia's fish, lobster, and potato wastes into a compost clambake. He maintains that anything organic can be composted as long as the ever-present bacteria are offered a precise diet of nitrogen and carbon. This allows them to heat the compost rapidly and keep it hot for two or three weeks, speeding decay. But Mr. Brinton warns that without a scientifically derived recipe, compost and public opinion will go bad, laying to waste the enormous potential of compost.

— Hannah Holmes

Public Service Electric and Gas Company. GSF Energy Inc., which is leasing recovery rights, expects its $10 million system to daily pump 1.5 million cubic feet of gas.

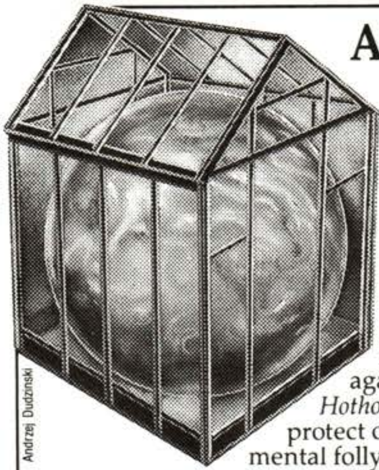
The Sky Mound project was initiated by the Hackensack Meadowlands Development Commission (HMDC) as part of its mandate to heal the Meadowlands, a once-pristine cedar bog which decades of unregulated dumping transformed into an open sewer of garbage. Sky Mound's site looms over the southeast corner of the Meadowlands, now 32 square miles of office complexes and condominiums, mudflats and several dozen other landfills. Edged by Amtrak railroad tracks and the eastern spur of the New Jersey Turnpike, shadowed by planes departing from Newark International Airport, Sky Mound will be viewed by 125 million commuters every year.


COURTESY HMDC

Sky Mound: 57-acre landfill edged by the NJ Turnpike and Amtrak rails.

This uncommon alliance of art and engineering will expose the public to the process of solid-waste disposal, and also provide an aesthetic solution for out-of-use dumps. Bob Grant, a spokesman for the HMDC, hopes that Sky Mound will help reverse the much-maligned image of this industrial gateway to New Jersey. Nancy Holt has a more philosophical ambition: "Landfills are the discarded regions no one wants to think about," she says. "But they're also a legacy of our generation. By making art out of a permanent landfill, we bring it back into our midst."

— Bill Breen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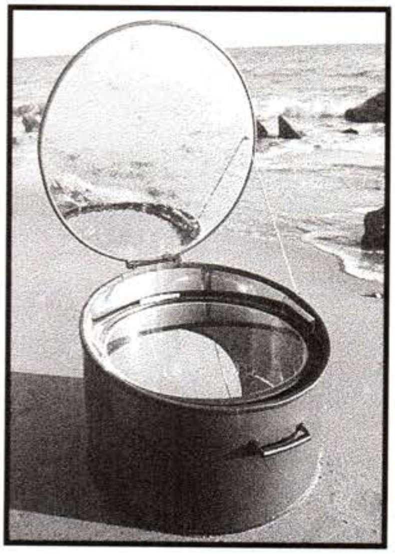

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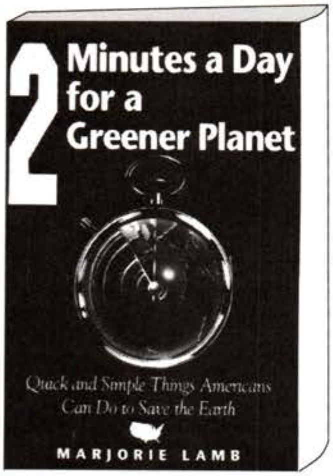
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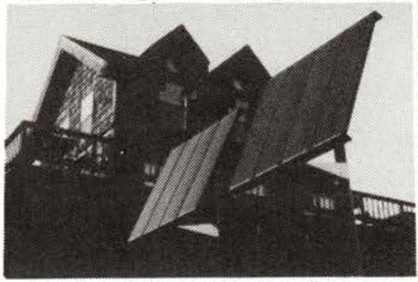

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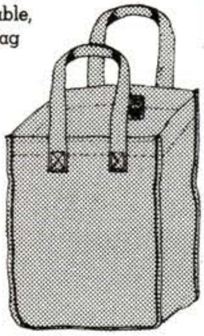

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The States Set the Pace on Global-Warming Issues

It's summer. It's hot. The long siesta that has paralyzed White House policy on global warming endures. But while the Bush Administration ponders whether the planet is actually heating up, one thing is certain: Global warming is a hot political issue, and state legislators, awakened by public concern, are stepping in to fill the leadership vacuum. In the past two years, nearly half of the nation's states have considered legislation to reduce their own gaseous contributions to "the greenhouse effect."

"States have to lead by example," says Vermont Gov. Madeleine M. Kunin. "State actions can give courage to Congress."

While the federal government slumbers, Vermont is acting to cut CO_2 emissions from fossil-fuel burning. Last year, Gov. Kunin issued an executive order that set a goal of 20-percent energy-use reductions and 15-percent greenhouse-gas reductions by the year 2000. Already, Vermont has outlawed CFCs in new-car air conditioners after 1993, and mandated the recovery and reuse of CFCs from large cooling systems.

Oregon, California, and Missouri are also addressing global warming. Each has commissioned a study of global-warming effects within the state, and has asked for a list of legislatable solutions that would reduce greenhouse-gas emissions. In California, dozens of environmental groups, including the Natural Resources Defense Council, the Sierra Club, and the League of Conservation Voters, are racing ahead of the state's study. Their "Big Green" initiative, a collection of powerful environmental measures that will go before voters in November, would mandate a *40-percent* cut in CO_2 emissions by 2010, and would ban new cars that use CFCs in their air conditioners by 1995.

Many policymakers agree that states can cut carbon emissions by supporting energy conservation and mass transportation, and by promoting such renewable, clean-energy sources as solar thermal, geothermal, solar voltaics, wind, and hydropower. (Oregon, for example, hopes to meet all of its future energy needs with geothermal and wind generation.)

So what about the feds?

It's not unusual for states to surge ahead with environmental issues, dragging federal policy behind them. Sometimes environmental legislation has to trickle *up*. Take California's strict auto-emissions standards: They are now part of the Clean Air Act reauthorization bill that many predict will become law. CFC policy is also in the bill; significantly, some 13 states have already put restrictions on CFCs and their less-damaging cousins, HCFCs.

Still, at the federal level, "global warming" is a term to be avoided. Although President Bush has called repeatedly for more study on climate change, he has lost no time chopping research and development spending for renewable energy to $139 million in

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1990, from a 1980 high of $847.9 million. Research and development for energy conservation plummeted to $194 million in 1990, from $405.6 million in 1980. President Bush proposes a further drop to $182 million in 1991, as well as the near-elimination of grants for state and local energy conservation. Department of Energy spokesman Phil Keif says a 15- or 20-percent reduction in global warming gases "is not necessary, environmentally or economically, at this stage."

Frustrated with such federal postulations, some states are banding together. In July 1989, the governors of New Jersey, New York, and Vermont called on every state to adopt a 20-percent cut in CO_2 emissions, to eliminate CFCs, and to push the federal government for an auto-efficiency standard of 42 mpg (it's been parked at 27.5 mpg for six years), all by the year 2000. Perhaps by then the feds won't act so cool toward the possibility of global warming.

— Hannah Holmes

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“I am a large mammal.”

Dave Foreman,
co-founder of Earth First!,
discussing the role of *homo sapiens* in nature. (*Harpers*, April)

“When we throw things away, they are taken to another planet.”

Choice number 2
in a multiple-choice garbage
quiz for schoolchildren.
(*Audubon Adventures*)

“It takes more than a picture of a pine tree to make a product environmentally friendly.”

Herbert Humphrey III,
attorney general of Minnesota,
on Mobil’s agreement to drop
the degradability claim from its
packages of Hefty garbage bags.

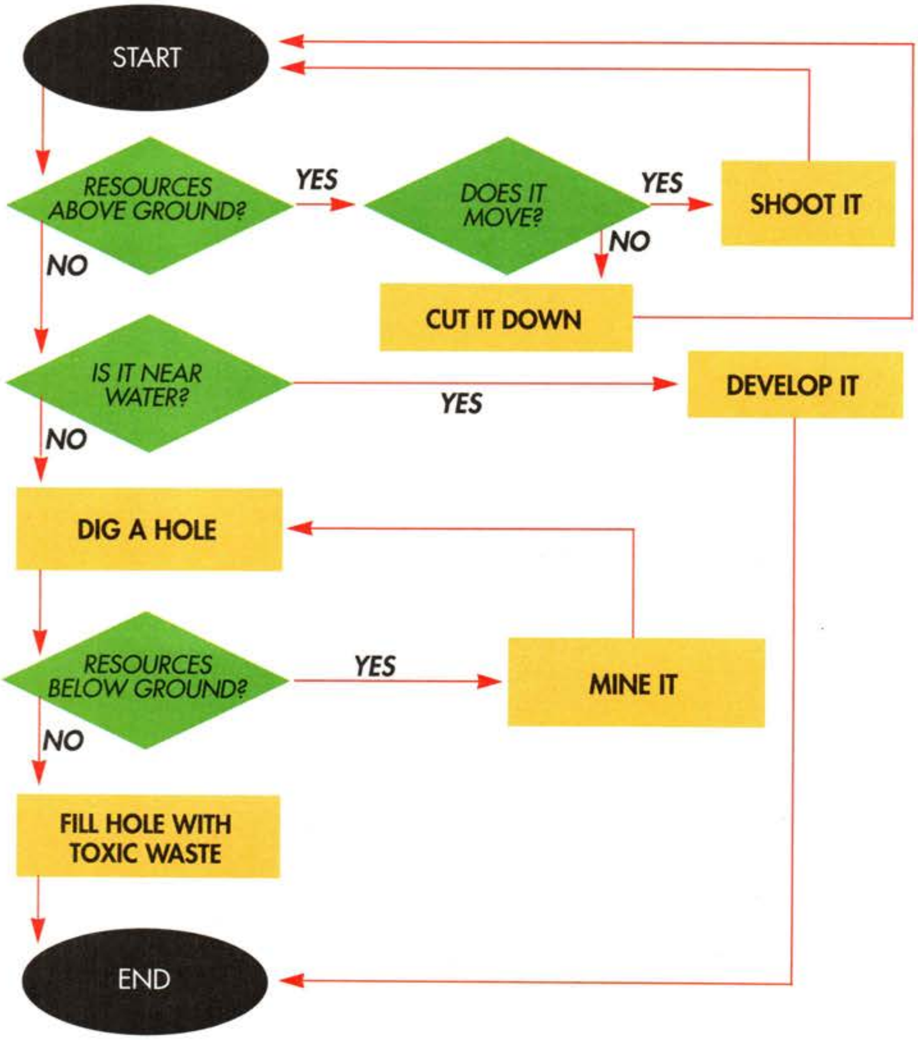
“We don’t go under the bridge to fish anymore. We wouldn’t go back unless we had an Amtrak schedule first.”

Mary Trammell,
who was fishing with friends in
the St. Johns River when a train
passed overhead and sprayed
raw sewage onto the party.
(*New York Times*, April 2)

“Americans did not fight and win the wars of the 20th century to make the world safe for green vegetables.”

Richard Darman,
U.S. budget director, expressing
doubt over the importance of
the environment in American life.
(*New York Times*, May 2)

The Maine Forest-Resource Algorithm



Using It Up

The diagram was devised by Mitch Lansky, a Maine resident and student of forestry who expanded it from a humorous Downeast saying: “If it moves, shoot it; if it doesn’t, cut it down.” He calls it the Maine Forest-Resource Algorithm.

Some people will criticize Lansky’s depiction of Maine’s natural resource-management efforts as a region-bashing over-simplification.

But consider this: In Maine, it began three centuries ago when timbermen started cutting the massive King’s Pines to supply the ship builders. Loggers moved on through the species as industry learned to use smaller and smaller trees for more and more purposes. Now, they’re down to cutting larch for wood chips.

Below ground, it started with gold and granite; now they’re mining copper and gravel. The gravel’s running out in some places, but mining it left lots of holes to put things in. Meanwhile there is a toxic-waste problem.

Could Mr. Lansky’s algorithm be more than a joke?

Adapted from an item that appeared in the March 30, 1990, edition of the Maine Times. *With permission.*

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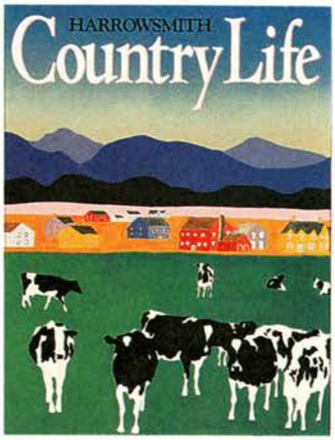

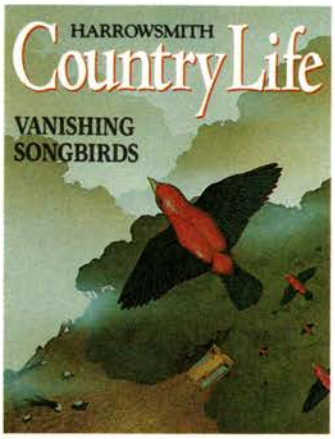

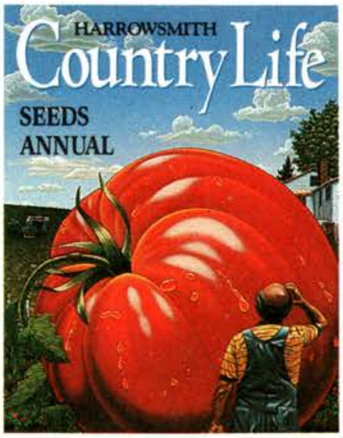

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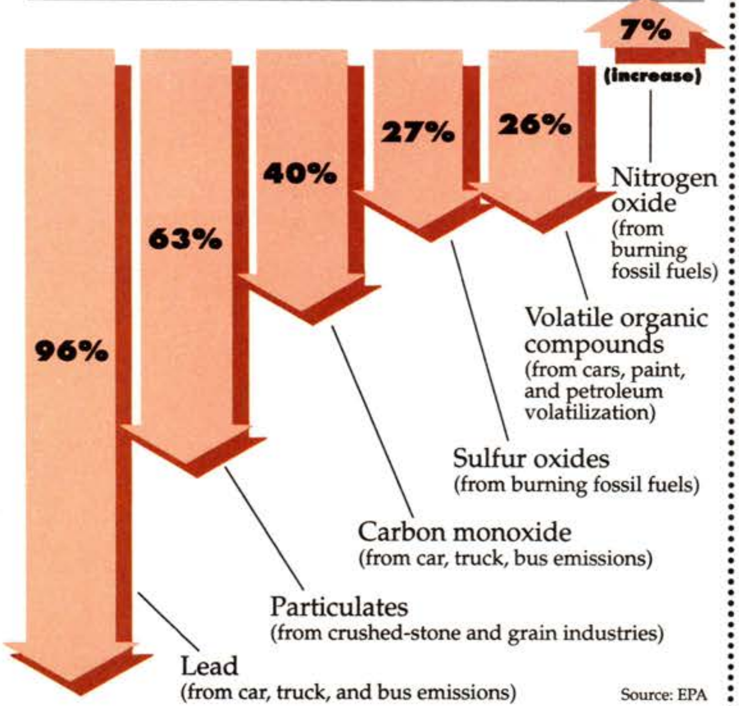

Source: EPA

Consumer Spending for (Toxic) Beauty Products

Hair Dyes (slightly to moderately toxic)	**$4.1 billion**
Nail Polish (moderately to very toxic)	**$704 million**
Nail Polish Remover (moderately to very toxic)	**$125 million**
Perfumes (moderately toxic)	**$9.9 billion**
Permanent Wave Preps (moderately to extremely toxic)	**$808.5 million**

Toxicity definitions: slightly toxic—from 1 pt. to 1 qt. equals a lethal human dose; extremely toxic—from 7 drops to 1 tsp. equals a lethal human dose.

Sources: U.S. Census Bureau, **GARBAGE**

Annual Lawn-Care Spending

Chemical pesticides	**$1.5 billion**
Chemical fertilizers	**$956 million**
Federal research into organic-lawn care	**$0**

Sources: USDA, Harvey J. Stengel and Associates, **GARBAGE**

Miscellaneous Facts

Ratio of people to cars

New York City: 4 to 1
Denver: 1.5 to 1
Los Angeles County: 2 to 1

Average tax per gallon of gasoline

Denmark: $2.51
United Kingdom: $1.55
United States: $.33

Calories burned hourly pushing a hand lawn mower

420 to 480

Source: Organization for Economic Cooperation and Development, Fall 1989

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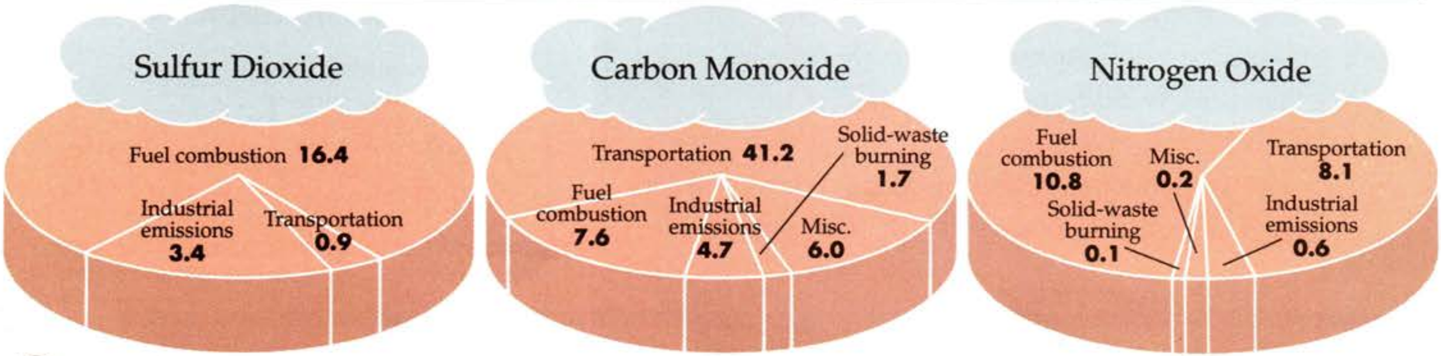

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PHOTOS: ROBERT KOURIK

NATURAL LAWN CARE

BY WARREN SCHULTZ

It's time to stop trashing the lawn. We've all heard that lawns are wasteful and nonproductive. But what do you suppose is transpiring on the lawn? The grass is. What's photosynthesizing, respiring, sucking in carbon dioxide, and spewing out oxygen? The grass is. We've been hearing an awful lot lately about how valuable trees are because they can convert carbon dioxide to oxygen and so lessen the greenhouse effect. Well, every tiny grass plant does the same thing. And they're four times as efficient as most trees. Multiply the 30,000,000 grass plants that make up an acre of lawn by the 30,000,000 acres of lawn in America and you've got a lot of heavy breathing.

Sure, people pour a lot of chemicals on their lawns. Homeowners apply an estimated five to 10 pounds of pesticide per acre of lawn each year: And nearly all of the dozen or so most popular over-the-counter lawn pesticides are suspected of causing serious long-term health problems. Captan and Benomyl, for example, are carcinogens and mutagens. Dursban has caused chronic kidney damage and mutagenic effects in laboratory tests, and 2,4-D has been linked to lymphatic cancer. Federal agencies like the General Accounting Office, the investigative arm of Congress, have been cranking out studies on the perils of these pesticides, and U.S. senators at subcommittee hearings have been tsk-tsking over the testimony of homeowners who claim common lawn chemicals have triggered excruciating headaches, nausea, extreme fatigue, and other debilitating illnesses.

But the good news is that you can grow a good-looking lawn without the "help" of these, or any other, dangerous chemicals. The chemical-free lawn does require us to do things differently, beginning with the way we think about our lawns. For starters, we need to get away from the putting-green mentality.

Stop treating your lawn as separate from the rest of your yard. Think of it as a garden of grass. If you have weeds in your lawn, pull them out or chop them. If disease strikes, find out why and eliminate the cause. If insects move in, don't panic: Accept some damage and use safe biological controls when necessary. Fertilize lightly. Mow high and frequently, and leave the clippings on the lawn.

• AVOID FERTILIZING FRENZY

Witness it each spring as soon as the snow clears: station wagons lined up at the garden center, customers hauling out bag after bag of lawn fertilizer bearing names like Turf Blaster and Ultra-Green. Back home, they dump, spread, and scatter the stuff on their lawns, then stand back and watch the grass pop.

Sure enough, the grass shoots up and turns so green it's almost blue. But weeds thrive along with the grass. Disease strikes. And the lawn mower barely has time to cool off before the grass needs cutting again. Even so, as soon as the grass begins to look the least bit pale, it's back to the garden center to load up again on fertilizer, and spread it all again, spring, summer, and fall.

For years turf experts encouraged that kind of behavior, but they've changed their tune. Finally the official word is, "Enough is enough!" Researchers have begun to realize

---

Warren Schultz is Editor-in-Chief of National Gardening *magazine in Burlington, Vermont, and author of* The Chemical-Free Lawn *(Rodale Press, 1989).*

At left: One of the country's oldest organically grown lawns, at Village Homes in Davis, California.

that all that fertilizer was doing more harm than good. Massive doses are a waste of money.

"New research has led us to change the way we think about fertilizing lawns," says Eliot Roberts, director of the Lawn Institute, a trade group for the turfgrass industry. Multiple feedings of high-nitrogen fertilizer are out of style. "We've found that the grass plant is a very efficient user of nitrogen," says Mr. Roberts. Babying the grass and pouring on fertilizer reduces that natural efficiency. "The more chemicals you use, the more you disturb the natural biological processes that convert organic matter into nutrients to keep the lawn going," he says. "Some of the best lawns I've seen are never fertilized, but they have an easy time converting clippings to nutrients. Once you get heavily involved with chemical fertilizers, you're increasing the growth rate of the plant and growing it to death."

> According to the conventional wisdom of ecology, the last thing you want in your environment-friendly yard is a lawn. You're probably convinced that all lawns are energy hogs and chemical sponges.
>
> Well, think again.

"Natural, organic-type fertilizers are the best because they are slow acting," says Mr. Roberts. "They include slow-release nitrogen, phosphorus, and potassium. This is how you get a lawn to grow slow enough so you don't kill yourself mowing it. "

To most of us, "organic fertilizers" means barnyard and manure. Not many of us are ready to spread fresh manure over our lawns. But there are plenty of other natural sources of nitrogen. You can find bags of dehydrated cow manure at just about any garden center. Most brands are deodorized and easy to handle, but at only a one- or two-percent nitrogen content, they're fairly expensive. Dried poultry manure is a better value, packing up to five percent nitrogen. One 40- or 50-pound bag of dried poultry manure will feed 1,000 square feet of lawn per year. Poultry manure is not odorless, but the smell dissipates rapidly once it has been spread. Other options include bloodmeal, cottonseed meal, fish emulsion, and mixed organic fertilizers.

For the Northern lawn, a single fall fertilizing works best, not the usual three or four annual applications. In the fall, photosynthetic activity remains high, but the cool temperature slows top growth. The plants make more food than they can use. The carbohydrate level in plant tissue, shoots, and roots builds up and carries over into the spring when it can be used to help the grass get off to a good start. In the South, lawns respond best to two or three light fertilizations from late spring to early fall.

• GETTING TO MOW YOU

When you use natural fertilizers, your lawn doesn't grow out of control. You will be able to mow less. However, you should mow more carefully. Mowing is the most important thing you will ever do to your lawn. Proper mowing can kill weeds, cure diseases, save water, and provide fertilizer.

If you're an average American homeowner, you spend 40 hours a year behind a lawn mower. Chances are your technique falls under one of a couple of mowing styles: You mow every week, at the same time the same way, or you wait until your backyard begins to look like a savannah and mow only when you begin to lose things in the lawn. Neither style is ideal.

What you should do is mow high and often, varying the frequency and blade height according to season. Each grass type also requires a different mowing height.

The longer the top growth, the deeper the root. A plant with deep roots will be better able to withstand drought and fight off diseases. And strong roots have more volume to store food that has been manufactured in the leaves. Simply stated, the longer the root, the healthier the grass. Every time the grass is cut, the root system is weakened to some degree. When the grass is cut severely — more than 40 percent — the roots stop growing.

In the North, two inches is usually the recommended maximum height for Kentucky bluegrass. But it will grow better if you cut it to three inches during the summer. During spring, you can cut it to two and one-half inches. Continue mowing at that spring height, just below maximum, until summer arrives. When temperatures reach the 80s consistently, or when more than two weeks pass without at least an inch of rain, it's time to raise the mower to three inches and reduce the frequency. In late summer as temperatures drop and rainfall increases, Northern lawn grasses will begin another growth spurt. Reduce the height by a half inch and mow more frequently.

For warm-season grasses, the principle is the same: Mow high in heat and drought because high mowing causes less stress and encourages deep root growth. But warm-season grasses do not go dormant during the summer, so you will have to mow high and mow frequently through that season. Try a maximum height of one inch for bermudagrass and two inches for carpetgrass.

By mowing high, you're reducing the stress on the grass and enabling it to compete better with weeds. You're also letting the grass shade the soil to inhibit germination and growth of weeds. And in your own, small-backyard way, you're doing your part to lessen global warming. A lawn allowed to grow to four inches tall, for example, fixes twice as much carbon dioxide as a two-inch-tall lawn.

Should you rake up the clippings after every mowing? No. Clippings do not, as once believed, cause thatch, a tightly packed layer of organic debris that develops between the soil surface and the green growth and can keep water, sun, and air from penetrating to the soil. Clippings start breaking down soon after they hit the

The key to a chemical-free lawn: Mow high and often, varying frequency and blade height with the season.

ground. In the process, they return a lot of nitrogen to the lawn, according to researchers at the University of Connecticut Research Station. They found that grass clippings began to decompose in one week. "And within two weeks, nitrogen from the grass clippings could be found in new grass," reports Dr. Charles R. Frink, head of the research station's soil and water department. "By the end of the third year, we estimated that one-third of the nitrogen on the plots came from grass clippings," he notes. The researchers estimated that the grass clippings contributed about 1.8 pounds of nitrogen per 1,000 square feet. "You didn't need any fancy instruments to see the difference," Dr. Frink says. "Where the clippings were left, the plots were much greener."

• WEED 'EM OUT

Proper mowing and fertilizing will give your grass a leg up on weeds. Don't believe the propaganda spread by the chemical companies, that you have to use herbicides or settle for a weedy lawn. It's just not true. You can have a good-looking, virtually weedless lawn without resorting to dangerous and expensive chemicals.

What is a weed anyway? That's up to you. If you want your backyard to resemble a golf green, then everything but bentgrass is a weed. But if you're looking for a pretty place to play ball with the kids or have a barbecue, then you can afford to stretch the definition of what is acceptable.

Society's perception of weeds changes over the years, and so does the roster of the worst weeds. A flower today may be a weed tomorrow, and vice versa. Take clover. Not too long ago, a clover lawn was a sign of prestige. The silky green petals and pastel flowers made delightful lawns, though not ones well suited for heavy traffic. Clover is soft to walk on. It mows well and smothers other so-called weeds. Clover seed was sold by the bushelful to estates, or mixed with grass seed for thick, combination lawns. Until the 1950s you'd as likely find clover in a home-lawn mix as bluegrass. Then a major grass-seed and chemical company launched a public-relations campaign disparaging clover. Clover is a weed! they declared. It doesn't belong in the modern lawn. Coincidentally they began selling a chemical to kill it. Their message carried the day, and now homeowners spend a lot of time and money trying to get rid of it.

It's up to you to decide how many weeds you can stand, and which ones absolutely have to go. But don't try to get rid of all of them at once. Pick the one that makes your skin crawl and your teeth grind and go after that. Get rid of it by pulling, mowing, or cutting, then get rid of the conditions that encouraged it in the first place.

In the long run, the best defense against weeds is a healthy lawn. If the lawn is growing thick and vigorously, there won't be room for weeds to elbow their way in. A lawn that's fertilized properly will start up early in the spring before cool-season weeds can germinate. A lawn

GREAT GRASSES

Kentucky Bluegrass

Tall Fescue

Ryegrass

Growing a lawn without chemicals is easier now than it ever was before because of new, vigorous, weed-beating, disease- and insect-resistant grasses.

Across the North and into the Midwest, the best grasses are named varieties of Kentucky bluegrass (Adelphi, Fylking, Glade, and Merion), turf-type tall fescue (Clemfine, Falcon, Galway, Houndog, Mustang, and Rebel), and perennial ryegrass (Manhattan, Pennfine, Pennant, Fiesta, Diplomat, and Omega).

Clippings left in place break down and return nitrogen to the lawn. Right: the amphitheater at Village Homes.

that's watered correctly will resist summer stress at the time when warm-season weeds are gearing up. Mowing correctly encourages thick grass growth and shades emerging weeds. Out in the jungle, it's survival of the fittest. If the lawn is fit and well cared-for, the weeds won't stand a chance.

Weeds are symptoms of problems. They'll grow in spots that grass can't handle — shady spots, compacted soil, improperly fertilized plots, areas that are too wet or too dry. Other conditions that weeds love include heavy use and mowing too closely, especially during the dormant season. Herbicides may kill off those weeds, but they don't do anything to correct the problem. Unless those conditions are changed, the weeds will return, requiring more and more herbicides.

But you can rid a lawn of weeds without chemicals. You don't have to spend a lot of time on your hands and knees, either. There are several long-handled tools — The Weed Popper is one, the Back-Saver/Weedr another — that enable you to pull out persistent weeds, tap-root and all, without much effort.

However, whenever you pull or dig a weed, there are plenty more waiting to replace it. You have to beat them to the punch by filling in the bare patch with lawn. You can reseed, and should always have a small supply of grass seed on hand for that purpose. But resodding will fill in the spot faster. Because sod is expensive and difficult to store, you can plant your own sod nursery. Pick a spot on the edge of the lawn or garden, maybe three feet by five feet. Then sow the species of your lawn grass in the bed. Whenever you dig up a clump of weeds from the lawn, dig a clump of sod to replace it.

High mowing can shade low-growing weeds and dormant weed seeds and keep them from developing. Studies at the University of Maryland show the remarkable effects of high mowing on weed populations. Researchers counted the weeds per 100 square feet in two patches of lawn. One was mowed at 1-1/2 inches, and the other at 2-1/2 inches. After the first year there were 15 weeds in the low-mowed areas, and only one in the high-mowed area. After two years there were 53 weeds in the low-mowed patch, and only eight in the high-mowed one.

• DEBUGGING

When you're raising a natural lawn, insects are never a big problem. That's because the soil is alive and the vegetation is untainted by chemicals, giving natural predators a chance to build up and battle pests.

The first step in natural-lawn insect control is learning not to over-react. You can't go running for the insecticide, even if it is organic, at the first sight of a bug. This means getting to know the enemies so that you know both what they look like and when to expect them. By keeping an eye on them, you'll be able to act before they can do a lot of damage. The point is to attack only when they're actually doing damage to your lawn.

If pests do appear, or if you've inherited a chemical lawn that you're trying to set straight, go for natural controls, either biological or physical, that wipe out every turf pest. Some are long-term diseases that control pests year after year. Others are one-shot, quick-kill remedies.

Let's take a look at some of the more common pests and how to handle them naturally:

Chinch bugs are season-long pests throughout the country. Chinch bugs at the nymph or immature stage, which do most of the damage, are bright red with a white band across the back. Control: beauvaria bassianna fungus, sabadilla.

Billbugs get their name from their long snout that ends in a set of mandibles. But the adult weevils aren't the troublemakers; it's the larvae that cause most of the damage to lawns, especially Kentucky bluegrass. The grubs are small,

For the humid South, plant bermudagrass (Tifway, Tiflawn, U-3, Guymon, Numex S-1), carpetgrass, centipedegrass, and zoysia. **In the dry Southwest,** plant bermudagrass, zoysia, blue gramagrass, and buffalograss. The last two are also good for the **Great Plains.**

GRASSES COURTESY O.M SCOTT & SONS COMPANY

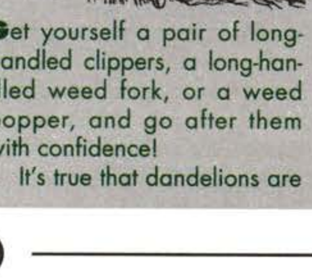
5/8 inch long, legless, and white with yellow-brown heads. (They look like puffed rice.) Control: rotenone and diatomaceous earth.

White grubs feast on the roots of Kentucky and annual bluegrasses, bentgrasses, and tall and fine fescues. They are the larval stage of scarab beetles, june bugs, rose and other chafers, and Asiatic and Oriental beetles, among others. Their C-shaped bodies measure from 1/4 to 3/4 inch long, and are blunt-ended and creamy white, with a hard yellow or brown head. Control: Hand pick and destroy beetles to reduce next year's grub populations. Control: Margosan-O (Neem), diatomaceous earth, predatory nematodes.

For the Northern lawn, a single fertilizing in fall works best. In the South, lawns do best with two or three light fertilizings from late spring to early fall.

Japanese beetle grubs are one inch long and white with brown heads. Keeping your lawn dry will discourage the adults. Control (adults): Hand pick, or use rotenone, Safer's Japanese-beetle spray containing pyrethrum. Control (grubs): milky spore (*Bacillus popillae*).

TWO WAYS TO BEAT DANDELIONS



Get yourself a pair of long-handled clippers, a long-handled weed fork, or a weed popper, and go after them with confidence!

It's true that dandelions are painfully persistent. Their long taproots are hard to pull, and small pieces left behind will regenerate into new weeds. But they're not indestructible. The key is to get to them when they're at their weakest, when they're blooming and food reserves in the roots are at their lowest. Dig out four to five inches of the root and you have better than an 80% chance that any remaining root pieces won't have enough strength to send up another stalk.

A weed popper pulls out the plants, roots and all, with a stomp. A long-handled weeding fork lets you do the job while standing.

Cutting with long-handled shears is even easier, although one cut won't do it. You have to cut off all the leaves and as much of the stem as possible. You have to cut lower than a lawn mower will reach, five or six times a year. The root will keep sending up new growth until it runs out of steam.

TWO WAYS TO BEAT CRABGRASS

You can virtually eradicate crabgrass with no work, no chemicals, and no weeding. Hard to believe? Studies at the University of Rhode Island showed that high mowing alone reduced crabgrass cover on a test plot to virtually nothing in five years. And high mowing combined with heavy fertilization eliminated crabgrass in just one year.

In an unfertilized plot, mowed at 1.2 inches, crabgrass cover increased from

Sod webworms prey on Kentucky bluegrass, bentgrass, tall and fine fescues, and zoysia. The worms are larvae of the buff-colored moth, which you'll see in late spring at dusk flying in zigzag fashion over the lawn. The moths are easy to identify by the pair of snoutlike projections on their heads and the way they fold their wings close to the body when at rest. Control: insecticidal soap, *Bacillus thurengiensis*, resistant grass varieties.

• NOW, DO NOT DISTURB

Lawn diseases become disasters only where turf is overmanaged. When chemicals are poured on the turf, they take a toll. The lush growth caused by high-nitrogen regimes makes grasses easy prey to disease. Fertilizers, herbicides, and fungicides all make their way to the soil, where they often destroy beneficial bacteria, upset the balance of the soil system, and give disease-causing fungi a chance to get the upper hand. The result: more diseases, treated with more chemicals, and an even less healthy soil. "The more chemicals you use, the more you disturb the natural biological processes that convert organic matter into nutrients to keep the lawn going," cautions Eliot Roberts of the Lawn Institute.

"Disease-causing organisms are always present in the lawn, ready to infect weakened plants when conditions become favorable," Eliot Roberts says. The chemical approach is to try to blast the fungi out of existence. But that's a hopeless battle. "Trying to kill the fungi does little good," he explains, "because complete control is never possible." Nor is it desirable.

The soil itself can keep disease in check. In healthy soil, disease pathogens are vastly outnumbered by non-pathogenic microfauna (amoeba, nematodes, and insects) and microflora (bacteria, actinomycetes, and fungi). They usually have the upper hand, and keep the disease-causing organisms in check — unless outside intervention upsets the equilibrium.

A stress, perhaps the application of a toxic herbicide, may allow the disease organisms to surge, and they go to work on the lawn. Spots, patches, and discoloration occur. Fungicides themselves can cause other disease pathogens to get the upper hand. In effect, fungicides often force you to trade one disease for another. Technical papers show more than 90 examples of turfgrass diseases that were made more severe as a result of fungicide applications.

That's why groundskeepers are constantly applying chemicals on golf courses, and why contract lawn services are a booming business: They've created a vicious cycle. That disease spiral exists on chemically treated home lawns, too, but you can break the cycle by adding beneficial microorganisms.

Healthy, virgin, chemical-free soil is teeming with good microorganisms. Bacteria and fungi work to keep the disease-causing fungi in check by competing with them for food. But there's evidence that actinomycetes may play a more active role in fighting pathogenic fungi. These microscopic plants are known primarily as decomposers of organic matter. They're responsible for the characteristic sweet smell of freshly worked soil. Plant pathologists at Michigan State University found that applying actinomycetes found in the products Lawn Restore, Lawn Rx, and Green Magic helped lawns recover from the lawn diseases necrotic ring spot, suppressed dollar spot, and reduced fusarium blight.

Applications of manure can also increase the actinomycete level in the soil. Topdressing with other organic matter such as compost, peat humus, and topsoil will do the same. Seaweed is another good natural disease fighter; naturally occurring hormones in the seaweed act as fungal inhibitors. Studies at Clemson University showed that applications of liquid seaweed to turf reduced fusarium and dollar spot.

It's time to stop throwing pesticides — and money — at our lawn problems. Once we do, we find that those problems are quite easy to handle with a little ingenuity and elbow grease.

The author's choices for turf tools, natural fertilizers, and pest-control products:

Gardener's Supply
128 Intervale Road
Burlington, Vermont 05401
(802) 863-1700
free catalog

Necessary Trading Company
P.O. Box 305
New Castle, Virginia 24127
(800) 447-5354
free catalog

Natural Gardening Research Center
Hwy. 48, P.O. Box 149
Sunman, Indiana 47041
(812) 623-3800
free catalog

Peaceful Valley Farm Supply
P.O. Box 2209
Grass Valley, California 95945
(916) 272-4769
free catalog

Ringer
9959 Valley View Rd.
Eden Prarie, Minnesota 55344-3585
(800) 654-1047
catalog $1

year to year, reaching a high of 54% in the third year, and dropping to 33% in the fifth year. But in an unfertilized plot mowed at 2.2 inches, the crabgrass cover steadily decreased from a high of 30% in the first year to 7% in the fifth year.

A combined program of heavy fertilization and high mowing really hastened the demise of the crabgrass. One plot received 20 pounds of nitrogen fertilizer, divided into three applications, one-half in November, one-quarter in June, and one-quarter in September. When that plot was mowed at 2.2 inches high, crabgrass coverage dropped to 8% the first year, and continued to decline to 2% after five years.

— *Warren Schultz*

ILLUSTRATIONS COURTESY O.M. SCOTT & SONS COMPANY

Homeowners in California are replacing lawns with drought-tolerant flowers.

NOVATO'S DISAPPEARING LAWNS

Restating the case for lawnless xeriscape.

BY MIA AMATO

Homeowners in Novato, California, are being paid up to $310 to rip out their lawns. It's all part of a pilot water-conservation project launched last year by the Northern Marin Water District. The "Cash for Grass" rebate program was created by the utility's general manager, John Olaf Nelson, to give residents an incentive to replace traditional turf lawns with "xeriscapic" landscaping using drought-tolerant plants.

Studies show that 33 percent of northern Marin County's water supply is used by homeowners to irrigate their lawns. The shallow-rooted turfgrass that carpets many of the district's lawns isn't suited to the semi-arid climate of California's central coast, claims Mr. Nelson.

Water companies around the nation are waiting to see the results from the Novato project, which offers rebates much like those awarded by power companies to homeowners who add insulation and other energy-saving devices. Ironically, even with rainfall levels only half of normal (14.6 inches so far this year instead of the average 27.2 inches), Novato is one California community that's not expecting a water shortage. That's because the Russian River system and the Sonoma, Mendocino, and Stafford lakes should provide adequate supplies for the region through the year 2015. "Our goal is long-term conservation," says Mr. Nelson. "The population is growing and we want to make sure we [can] serve the expected demand."

A drive through the streets of Novato shows xeriscapes in every neighborhood. Scores of homeowners have applied for the rebate, which pays $50 for every 100 square feet of lawn (up to the $310 maximum) replanted with water-conserving species. Each converted property represents a potential water savings of as much as 120 gallons per day in peak-use months.

Getting a $310 check from the water company helped prompt Paul Sartorio to rip the grass from his front yard. "I was getting real tired of mowing the front lawn," he explains. "It was starting to look bad, too, and I was at the point of deciding between putting in some new sod or going low-maintenance." Now, his front yard sports a dry creek bed of stone and crushed rock, edged with coral bells and other drought-tolerant flowers and goundcovers.

The rebate program requires that grass be replaced with "living material of a xeriscape nature." No checks are written for turf replaced with crushed rock, gravel, or paving. Other requirements include a minimum four inches of water-conserving mulch to cover the replanted areas, and a drip-irrigation system for trees and shrubs.

Despite the cash payment, actual money savings to the homeowner is minimal, shaving only two or three dollars from the water bill. Conversion costs for residents who have participated in "Cash for Grass" range from $1,200 for do-it-yourselfers to $5,000-9,000 for professional landscaping jobs. The utility is currently surveying homeowners to determine what motivates them to pursue water-wise gardening, since clearly it's not the rebate alone.

Not surprisingly, local sod farmers — whose livelihood depends on turfgrass sales — are alarmed at the sight of homeowners tearing up their lawns. "Turf doesn't waste water, people do," exclaims Bill Gill, owner of the Grass Farm in nearby Morgan Hill.

To counter xeriscapes, trade groups like the American Sod Producers and the Northern California Turfgrass Council are proposing improved, automated irrigation systems and new grass varieties, such as tall fescues, that can get by with less water. John Nelson concedes that "islands of green" surrounded by drought-tolerant plantings will help conserve water. Nevertheless, "Cash for Grass" is tentatively funded for its second year, pending an analysis and report that Mr. Nelson expects to complete this fall.

If you want to replace your turfgrass lawn with a xeriscape, the East Bay Municipal Water District (the utility for the cities of Berkeley and Oakland) has created a beautifully illustrated book, *Water Conserving Plants and Landscapes for the Bay Area.* With a how-to section and over 300 color photographs of drought-tolerant plants, it's a bargain by mail order for $11 from: EBMUD, Dept. GM, P.O. Box 937, Alamo, CA 94507.

Mia Amato is a writer and editor living in San Francisco. Her articles on gardening and the film industry have appeared in Ms., Fine Gardening, Flower & Garden, *and the* San Francisco Examiner.

The last kitchen revolution happened in the generation between 1920 and 1945. Capping a trend that began in the 1890s, kitchens once and for all graduated from the Victorian service room (and, in many cases, *servant's* room) to become the housewife's own domain and a center of family life. No longer hidden in the basement, kitchens moved to the living floor. The bulky, freestanding basin and iron stove were replaced by continuous counters, built-in cabinets, and streamlined appliances. And in the span of one generation, electricity went from a futuristic experiment for the urban well-to-do to a middle-class necessity.

When we see pictures of a 1950s or even '30s kitchen today, it may look old-fashioned, but we recognize it as essentially the same modern room.

Changes since that period have focused on small appliances, surface materials, and fashion. No true innovation in design or use has occurred since the Second World War.

But I think we're on the brink of the next design revolution. Not just coincidentally, the kitchen we know now is in cahoots with an energy-intensive, throwaway age. As we rethink the very meaning of words like "convenience" and "garbage," the kitchen will be transformed. I predict that the new kitchen will be designed in response to bulk packaging (will pantries and utility sinks come back?), food-waste composting, separation of recyclables, water conservation, and energy efficiency.

PHOTOS: ROBERT PERRON

TOWARD THE NEXT KITCHEN

What follows comes from David Goldbeck, author of *The Smart Kitchen*. This is a how-to article, not one from a visionary theorist: You'll find very practical, here-and-now guidelines for designing or adapting your kitchen today. It'll get you thinking, though, about what an impact kitchen design has on environment-sensitive function; let's insist on a hard look from builders and remodelers.

— Patricia Poore

TOWARD THE NEXT KITCHEN

How to Stop Wasting Energy • Collect Compost • Grow Food Indoors

by David Goldbeck

It's time to take a fresh look at how our kitchens are designed and equipped. Reason number one: Kitchens are the site of a substantial waste of energy. Largely because of poorly designed appliances, kitchens in the United States, according to the American Council for an Energy Efficient Economy (ACE^3), utilize 20 to 25 percent of household energy. So waste of resources in the kitchen is directly responsible for the costly construction of new power plants, and it is indirectly responsible for poor air quality, the possibility of global warming, and other environmental ills.

Furthermore, modern kitchens are not enough involved with food itself: Design should accommodate more actual food production — conveniently. Baking, canning, seed sprouting, and food dehydrating are all easier when the kitchen is set up for such activities.

Third, there has to be an active concern for recycling kitchen-generated wastes. As with food production, the composting of food wastes and materials recycling would be helped along by paying attention to those needs.

Finally, I'm concerned about the direction our eating habits are going. I believe that a reason for the declining interest in cooking is that our kitchens have not kept up with changes in lifestyle. (The microwave oven is too little, too late, and it can't even brown a muffin.) If cooking of real food is to survive, kitchen design and appliances must be improved; otherwise, we will abdicate to mass producers one of the true pleasures of life and an important source of health: fresh food. We'll be condemned to a "boil 'n bag" and "slit 'n serve" future.

Enough pontificating. Below, I touch on a few things to keep in mind about the workaday necessities. My wife Nikki and I, both food writers, have used every one of these suggestions in the "demonstration kitchen" in our own house. And it doesn't look futurist ... more like an easy-to-clean farmhouse kitchen.

•THE KITCHEN SINK

My kitchen has two sinks: one for food preparation and one reserved for dishes, pots, and cleanup. As it makes food preparation so much easier, it is a worthwhile indulgence. Two sinks mean plenty of space for two workers. Having two sinks allows you to save the dishes for washing at a more convenient time.

Sinks are available with one, two, or three bowls, in a variety of dimensions. A food-preparation sink rarely needs more than one bowl unless there is no drainboard or adjacent counter. A dishwashing/utility sink, however, should have two bowls. And if you have a three-bowl sink, you can conserve water while you wash the dishes by "ponding" the water. That is, you can fill each sink with increasingly cleaner water — soapy water, rinse water, and then final rinse. (If you'll have only one sink, get triple-bowl model, especially if there is more than one cook.)

Many faucet manufacturers make drinking fountains and soda-water dispensers that can be installed in the kitchen sink. Low-calorie convenience! An added attraction: fewer bottles to recycle.

Saving water not only reflects an active concern for the environment, but it also saves you money. Less pump usage means lower electric bills, as does reduced water heating. Less water going to the septic system helps maintain its efficiency and decreases the demand for central sewer systems. It also makes it possible to install smaller septic systems and thus inhabit land that would not support a larger one. Here are some water-saving devices:

Aerators: Aerators do not increase or restrict the flow of water, but by adding air bubbles to the water, they make the flow seem greater than it actually is. This effectively reduces water usage by 50 to 75 percent. Most good faucets come with aerators.

Faucet design: Some faucets are designed better than others for reducing water use. Single-level faucets, for example, make it easy to flip the water on and off at a predetermined mixture, saving energy and water. Some faucets are also being made with flow restrictors that can be adjusted to reduce water flow up to 50 percent. Our kitchen contains a single-lever faucet with built-in aerator at the utility (dishwashing) sink.

Add-on flow restrictors: These inexpensive devices reduce the rate of water flow through the faucet by 50 to 75 percent. They are common in showerheads and can be added to any faucet.

Greywater usage: The irrigation of landscape with greywater (waste water) is an ecological necessity in some areas. Generally, shower/tub, bathroom sink, and laundry (diaper-free) water is best. However, in a two-sink kitchen where one sink is used exclusively for vegetable preparation, or a double sink is properly plumbed and used, greywater usage is possible. (Check local plumbing codes.)

• APPLIANCES & ENERGY

Before the fuel crisis of 1973, kitchen design barely considered energy; remarkably, things haven't changed much since then. When I received the results of a free energy audit from my local utility, I was amazed to find that there was no mention of appliance efficiency. It certainly is a lot simpler to replace a refrigerator and save 40 to 50 percent on its operating cost than it is to insulate the floor, which is one of the suggestions I did receive.

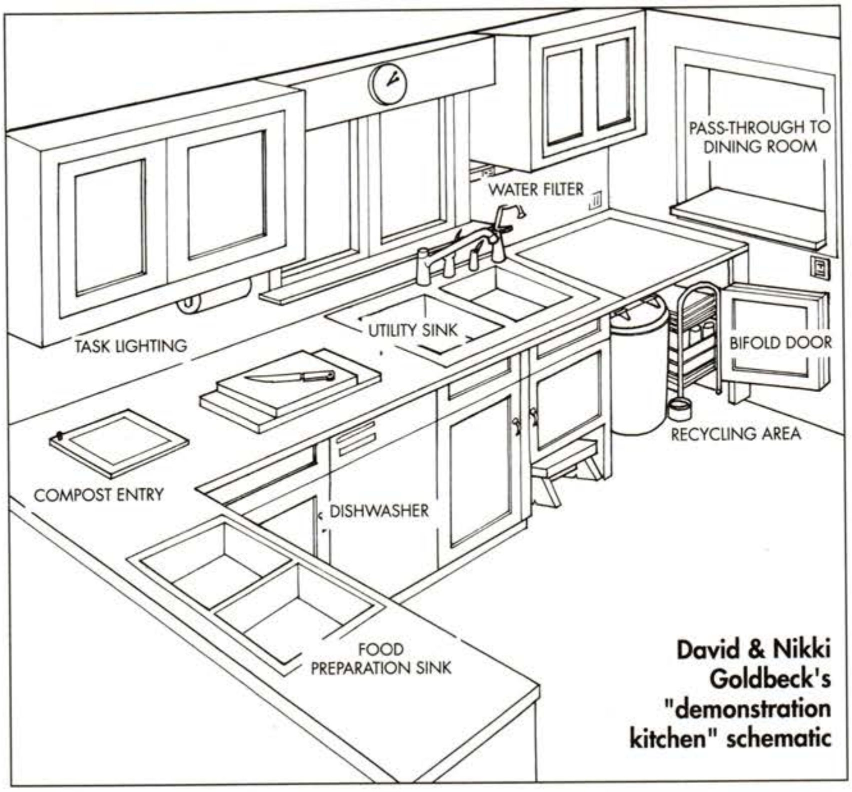
Does it matter? As reported in John Rothchild's *Stop*

David Goldbeck is a food authority, book author, and sometime kitchen designer from Woodstock, New York. He's concerned that "unless we build convenience into our kitchens rather than buying it from the food-processing industry ... all the joy may one day be lost."

Burning Your Money (1981), scientists at California's Lawrence Berkeley Laboratory estimated (in the 1970s) that if everyone in California had an energy-efficient refrigerator, the state could save five percent of its energy, or the energy generated by two nuclear-power plants. The two power plants (at that time) cost $3 billion to build; 16 million refrigerators cost $750 million. It would actually be cheaper to give the refrigerators away than to build the nuclear plants.

After years of resistance by manufacturers and a veto by President Reagan, Congress passed the National Energy Conservation Act in 1987. This law establishes minimum efficiency standards for home appliances and heating and cooling equipment. The standards for dishwashers took effect on January 1, 1988, and require an air-dry option. The standards for many other appliances take effect in 1990.

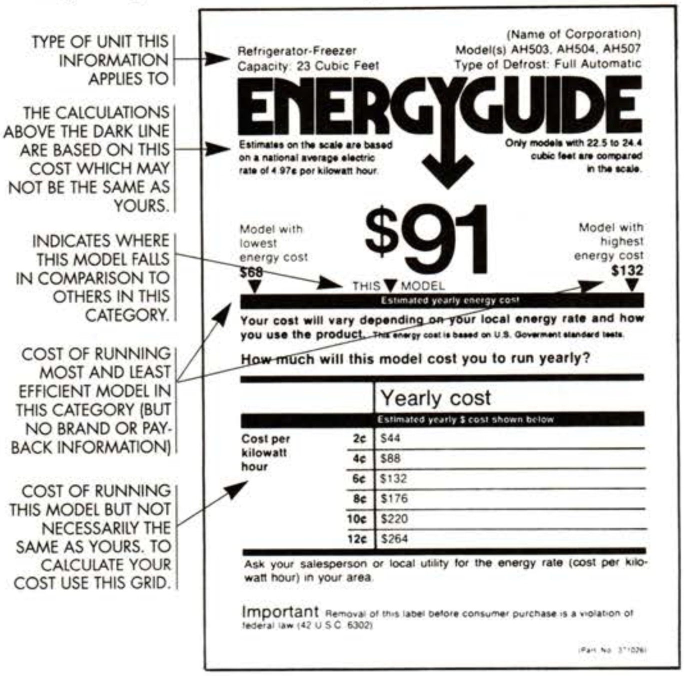
These standards mandate appliances to be 10 to 30 percent more efficient than the average model before legislation. The American Council for an Energy Efficient Economy , a Washington-based public-interest organization, estimates that this will save the average household about $30 per year. But even more important, it will help reduce the need for new power plants.



David & Nikki Goldbeck's "demonstration kitchen" schematic

Have you ever noticed black and yellow labels glued to the front of major appliances? These government-mandated EnergyGuide labels are a valuable consumer aid, enabling "comparison shopping." The energy-efficiency ratings (EERs) that appear on the labels provide an estimated annual operating cost for that particular appliance. Refrigerators, refrigerator/freezers, freezers, dishwashers, water heaters, clothes washers, room air conditioners, and furnaces must all bear the EnergyGuide label.

Appliances are still made with a broad range of efficiencies; because some, like the refrigerator, have a lifespan of 15 to 20 years, your choice has a long-term effect. In 1986, if you used the EnergyGuide label and purchased the most efficient refrigerator available (Whirlpool ET17HK1M), it would have cost you $60 more upfront, according to ACE^3. But the extra expense would have been paid back in 30 months from reduced energy consumption — a 45-percent rate of return. After this period, the unit would continue to save about $24 dollars per year for the life of the refrigerator.



TYPE OF UNIT THIS INFORMATION APPLIES TO

THE CALCULATIONS ABOVE THE DARK LINE ARE BASED ON THIS COST WHICH MAY NOT BE THE SAME AS YOURS.

INDICATES WHERE THIS MODEL FALLS IN COMPARISON TO OTHERS IN THIS CATEGORY.

COST OF RUNNING MOST AND LEAST EFFICIENT MODEL IN THIS CATEGORY (BUT NO BRAND OR PAY-BACK INFORMATION)

COST OF RUNNING THIS MODEL BUT NOT NECESSARILY THE SAME AS YOURS. TO CALCULATE YOUR COST USE THIS GRID.

Refrigerator-Freezer
Capacity: 23 Cubic Feet

(Name of Corporation)
Model(s) AH503, AH504, AH507
Type of Defrost: Full Automatic

ENERGYGUIDE

Estimates on the scale are based on a national average electric rate of 4.97¢ per kilowatt hour.

Only models with 22.5 to 24.4 cubic feet are compared in the scale.

Model with lowest energy cost **$68**

$91

Model with highest energy cost **$132**

THIS MODEL

Estimated yearly energy cost

Your cost will vary depending on your local energy rate and how you use the product. This energy cost is based on U.S. Goverment standard tests.

How much will this model cost you to run yearly?

		Yearly cost Estimated yearly $ cost shown below
Cost per kilowatt hour	**2¢**	$44
	4¢	$88
	6¢	$132
	8¢	$176
	10¢	$220
	12¢	$264

Ask your salesperson or local utility for the energy rate (cost per kilowatt hour) in your area.

Important Removal of this label before consumer purchase is a violation of federal law (42 U.S.C. 6302)

(Part No. 371026)

At left is a diagram of the EnergyGuide label. Notice that the "estimated annual operating costs" do not necessarily predict your actual operating cost; that depends on personal use and your local utility rates. Although energy consumption for the most and least efficient of this type of appliance is also given for reference, brand and model numbers are not provided. The government leaves it up to consumers to find more efficient models on their own. But don't despair. The Most Energy Efficient Appliances, published by ACE^3, is a pamphlet that lists — by brand name, serial number, and cost — the most efficient refrigerator/freezers, freezers, dishwashers, clothes washers, gas furnaces, oil furnaces, and oil burners. Also included is the Council's formula for determining the actual energy expense of different products. The booklet is updated every year and costs $3 from: ACE^3, 1001 Connecticut Ave., N.W., Suite 535, Washington, DC 20036.

Refrigerators

Most people are amazed when they find out how much they spend to run a refrigerator and a freezer each year. An 18-cu.ft., frost-free model costs anywhere from $120 to more than $250 of your electric bill yearly, depending on the unit and where you live. The experts believe that refrigerators could use as little as 200 kilowatt-hours per year. This translates into astonishing savings — down to $16 per year (at an average electric cost of 8 cents per kilowatt-hour). The average unit now in use consumes about 1,300 kilowatt-hours per year; the average new model, just under 1,000. This projected energy savings could be had through a better self-defrosting system, elimination of door heaters (or adding switches for them), and by a more effective separation of the refrigerator section from the freezer section. Adding a more efficient compressor motor and additional and better insulation could further reduce energy usage. And decreasing the number of defrost cycles not only saves energy, but it also lessens food dehydration. The Japanese, Germans, and Danes are already mass-producing such units.

In the U.S., Larry Schlusser, a Ph.D. formerly with the University of California's Quantum Institute, has founded the Sunfrost Company [P.O. Box 1101, Arcata, CA 95521] to manufacture super-efficient refrigerators. His 16-cu.ft. model, for example, uses 180 kilowatt-hours per year — a 70- to 80-percent savings.

Many utilities offer rebates or other benefits to encourage consumers to purchase energy-efficient refrigerators. These companies' actions acknowledge the reality that it's cheaper to conserve energy than to build new power plants. If your utility doesn't have a rebate program, find out why. Also, Amory Lovins, co-director of the Rocky Mountain Institute, warns that areas without refrigerator-rebate programs are "probably dumping grounds for inefficient models that don't sell well in other parts of the country."

Energy cost is affected by the size of the refrigerator. The bigger it is, the more total energy it uses. However, large units can be more efficient per cubic foot than smaller units, so check ratings and divide by cubic feet.

The following are "standards" for sizing a refrigerator, freezer, or combination unit. In the fresh-food section, 8 to 10 cubic feet is judged adequate for a family of two, plus 1 cubic foot for each additional person, plus 2 more cubic feet if you do a lot of entertaining; the freezer space should provide approximately 2 cubic feet per person. Note that these figures are on the high side and should be adjusted based on your lifestyle and other storage options.

Insulation: The more the better. Polyurethane foam is preferred, because it has the best insulating qualities. If you think insulation doesn't matter, touch the outside of an older refrigerator. I bet it's cold.

Unfortunately, chlorofluorocarbons (CFCs) used in refrigerator coolant and insulation are associated with the destruction of the ozone layer. If and when a safe replacement comes on the market, give it preference. One promising technique utilizing "evacuated panels" with a vacuum similar to thermopane windows may appear in the future.

Method of defrosting: The defrost capabilities significantly affect the amount of energy the refrigerator/freezer uses. Automatic-defrost units utilize 20 to 40 percent more electricity than those with manual defrost. Units are available with the following defrost options: manual, partially automatic, and automatic.

Manual-defrost units are the most economical, if you know how to use and defrost them. (For example, making sure foods, particularly liquids, are always covered will reduce frost buildup.) Frost should not be allowed to thicken by more than 1/4 inch.

Partially automatic defrost or cycle defrost is a hybrid. The freezer must be manually defrosted several times per year, whereas the refrigerator does not require defrosting. In general, the best partial-automatic is more economical than the best fully automatic unit. (To calculate the cost of differing features, contrast the EER labels of comparable models.)

Automatic defrost requires no effort, but you pay for this convenience.

Temperature of freezer space: A zero-degree freezer is a must if you store a lot of food, particularly for long periods. Some new freezers have a special "super freeze" area that lengthens the storage life of food. Freezers located in single-door refrigerators may only give you 15° F, which is not cold enough for long-term storage.

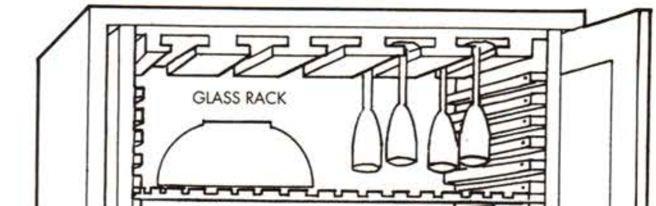
Condensation controls: Contradictory as it sounds, heaters are installed to prevent condensation on the outside of refrigerators. To reduce energy use, most good-quality units have switches to turn these heaters off during dry weather.

Type of motor: The lower the wattage (shown on the ID plate), the better. More efficient motors, however, may be somewhat noisier.

Resist the temptation to sell the old refrigerator for a few dollars. You're not doing anyone a favor by passing it on, since it will cost a lot to run and waste valuable fuel.

The really innovative might take inspiration from Richard Villelli, who built a refrigerator that uses the seasonally cold air outside his home in Bonners Ferry, Idaho. Conceptually, it is a refrigerator with small closable vents in the rear that allow air from the outside to circulate within the box. You will probably want to have a commercial refrigerator fabricator build the entire unit, as Mr. Villelli did. To temper the air in the natural refrigerator (and keep nosy animals away), the side with the vents faces an unheated room rather than being exposed directly to the outdoors. Although such custom refrigerators are more expensive than standard ones, the accumulated months of free refrigeration may eventually balance this.

For generations before refrigerators, people took advantage of natural cooling. (Earth temperature remains a constant 40° to 50° below a three-to-four-inch depth.) Most homes have a corner, cellar, or cabinet that stays cooler than the rest of the building. Modern home dwellers can capitalize on the ancient method and possibly utilize a smaller refrigerator, thus obtaining long-term energy savings.



The Finnish Drying Cabinet is reminiscent of open-shelf air drying — and practical.

Dishwashers

Without being inhibited by the thought of a stack of dirty dishes, people are more inclined to cook. Dishwashers can save substantially on the amount of hot water used as compared with washing dishes by hand. According to a study done at Ohio State University (1988), the average dishwasher uses 9.9 gallons of water compared with 15.7 gallons on average for an equal amount of dishes hand washed. (This assumes rinsing under running water vs. using a loaded dishwasher.)

Always air-dry dishes, as towel drying is unhygienic and boring. The Finnish drying cabinet has been in use in Finland for more than 60 years but is virtually unknown in North America (although similar, open wall racks were used in colonial America and are seen in English kitchens today). The cabinet is basically a kitchen cabinet that's had its bottom removed and its shelves replaced by dish racks. The cabinet is generally mounted over the sink, but I mounted a metal drip pan underneath so that it can be hung next to the sink. I also added a wineglass rack. Close the doors and the dishes disappear from view as well.

I used pocket-door hinges on the cabinet so the doors could slide into either side of it, providing maximum access when loading wet dishes. This door format is not necessary to the design, but produces a cabinet that is not only easier to use, but also safer — no bumped heads on open doors. The doors could be eliminated, of course.

The selection of dishwashers has become much easier as the result of the EnergyGuide labels. According to the Association of Home Appliance Manufacturers, 80 percent of the cost of running a dishwasher is heating the water. The following are the important features to consider in selecting a dishwasher because they affect the amount of hot water you use:

Built-in water heater. For dishwashers to work properly, they require water heated to 140°F. One way for you to get this hot water, of course, is to keep your household water heater set this high — quite a waste of energy, since no other domestic use requires water this hot. However, now many dishwasher manufacturers have installed internal heaters so that domestic hot water (usually 120°F) is boosted by a heater within the unit itself. This feature is highly recommended, since it can save up to 10 percent of your home's total hot-water bill. Some units may even be able to heat cold water, especially useful when the dishwasher is located some distance from the water heater.

Less hot-water usage. Dishwashers vary in the amount of hot water they use. By selecting a model that uses less, you conserve energy and another dwindling resource, water. Check manufacturers' literature for comparisons.

Variable cycle selections. Formerly, dishwashers had very few choices of cycles; you used the same amount of water no matter how dirty the dishes or how full the unit. Shorter cycles can save up to one third in electricity. Machines now come with a range from "light wash" to "pot wash." All dishwashers made after January 1, 1988, must have an option to dry without heat. This saves an estimated 15 percent on the unit's electricity. Tips for efficient use:

All that green in this Branford, Conn., kitchen is beautiful — even better, it's a year-round vegetable garden.

- Use only when full. If you feel your usage is such that you won't run the machine within a reasonable amount of time, use the "rinse and hold" cycle. This cycle will clean away food debris so there is no odor or dried-on food, but it will not give a thorough cleaning. (Don't overuse this cycle, as it uses three to seven gallons of hot water.)
- Don't pre-rinse dishes in the sink if you do dishes once a day. If you must pre-rinse, use cold water. Normally, just scraping off debris is enough for new dishwashers.
- Use "air dry" to dry, or shut the unit off before the drying cycle and open the door.
- Always use the shortest cycle for the load.
- Run at off-peak hours (if option exists in your area).

Cookers

Stove design needs some innovative thinking. Although there are more choices than ever before, most of the new options do not offer any great improvement over their predecessors. For example, although most professional cooks agree that a gas cooktop and an electric oven are the preferred appliances, you cannot buy a single unit that contains both features. Rather, the focus is on such equipment as microwave ovens, which present new marketing opportunities but do little for the art of cooking.

The question of fuel efficiency is less crucial than one might think because cooking appliances don't consume or waste immense amounts of energy. This does not mean that efficiency should be ignored, but that other factors — cooking capability, emissions, and safety — have more weight in this decision. In terms of "end-use efficiency," even the American Gas Association admits that electricity is more efficient (45 percent versus 79 percent). This means that you get 34 percent more heat for your dollar out of electricity at the burner. (However, when hidden costs such as the power needed to generate electricity and power lost through transmission are figured in, electricity doesn't fare as well.)

continued on p. 42

It isn't easy being green. No matter how good we try to be, we realize that our standard of living makes a pristine environment impossible. The relationship between our lifestyle and our polluting seems so complex, and sometimes we feel so helpless when confronted with global or even local degradation, that it's easier to blame the big, blatant polluters than it is to identify our own contribution.

One individual has taken a more objective view. Reader Norman Getz calculated how his environmentally conscientious lifestyle translates into pollution. Pound by pound, he totaled the five types of air pollutants his family generated in one year, and mailed the results to GARBAGE. We present to you...

Confessions of an Air-Polluting Family

One Man's Secret Shame: "I Realized That My Family Are Polluters!"

An associate told me that I pollute. Initially, I was offended. I'm an environmentally minded person. I don't litter or use products with fluorocarbons. I return used oil for recycling, and I use only natural fertilizers on my lawn. I buy laundry detergent that doesn't have a lot of phosphate. I don't dump hazardous materials, such as drain cleaners, down the sewer.

But after thinking about it, I realized that my family — my wife, our baby son, and I — *are* polluters. We pollute directly and indirectly, avoidably and unavoidably, through our wastewater discharge and trash disposal, the exhaust from our cars and our furnace, and through our use of electricity. So I set out to quantify

other volatile organic compounds, as well as condensible organics. Some react with nitrogen oxides to form Earth-warming ozone smog, and some are carcinogenic.

NOx, Nitrogen Oxides: Gases that work with organics and carbon monoxide to form smog. They also form acid rain, harming plants, animals, and buildings.

blood to carry oxygen. It combines

contributed in one year, 1988.

WHAT WAS MEASURED

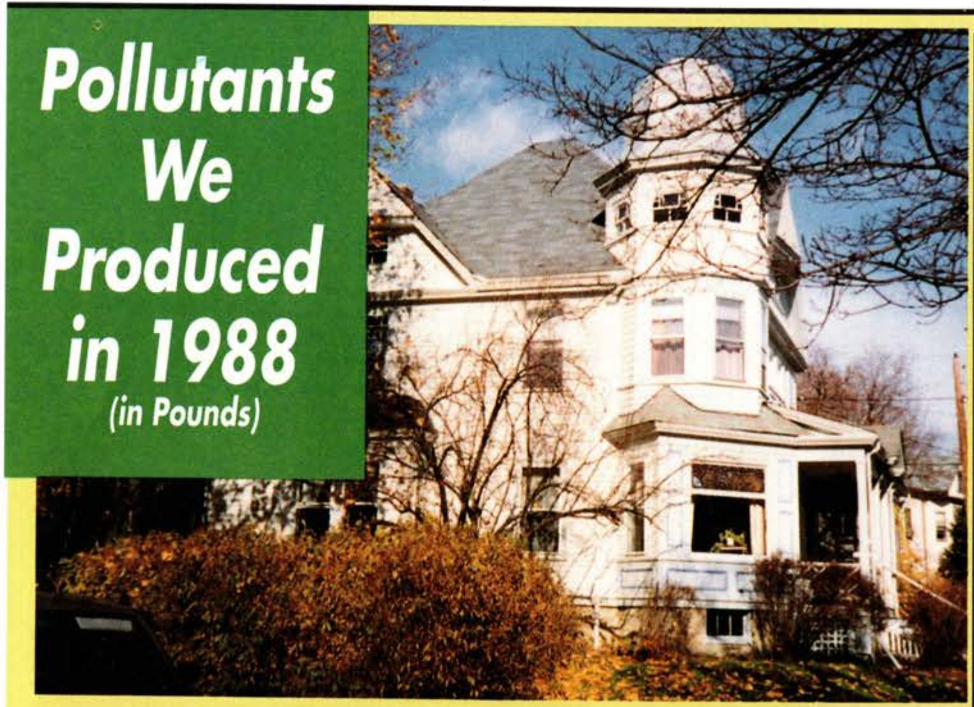
Total Organics: Hydrocarbons and aggravates respiratory problems and leads to acid rain.

CO, Carbon Monoxide: A toxic gas that reduces the ability of readily to form CO_2, the primary global-warming gas.

Particulates: Tiny particles of smoke, dust, and liquids that can cause acute respiratory problems; they also serve as a vehicle for toxic heavy metals.

Pollutants We Produced in 1988

(in Pounds)



WASTE-TO-ENERGY EMISSION (FROM GARBAGE)

Total organics: 0.04. *NOx:* 8.10. SO_2: 4.50. *CO:* 0.25. *Particulates:* 0.14.

We generated about 1.7 tons of trash, close to the national average. We recycled glass and newspapers, and composted clippings and leaves, but we offset any gains in waste reduction by using disposable diapers — about 27 percent of our trash. Our sewer system does not have secondary treatment, so burning diapers with our other trash at our regional waste-to-energy facility seemed no worse than burdening the sewer system.

Sources: Entropy Environmentalists, Inc.; Radian Corp.; National Air Pollution Control Administration.

ELECTRICITY-GENERATION EMISSIONS

Total organics: 1.8. *NOx:* 51.4. SO_2: 73.7. *CO:* 0.02. *Particulates:* 4.9.

We used about 6,600 kwh of electricity. Although we have oil heat, an electric atomizer fed oil into the furnace, an electric pump circulated water through the radiators, and a mixing pump kept our hot-water tank evenly heated. In 1988, our electricity was generated entirely from fossil-fuel burning. Ninety percent of that was No. 6 oil with one-percent sulfur content; the other 10 percent was natural gas.

Sources: Air Pollution; Chemical Engineer's Handbook; Office of the Federal Register and National Archives and Records Admin.; Babcock and Wilcox Co.; Boston Edison Co., 1988 Annual Report.

HEATING-OIL EXHAUST

Total organics: 10. *NOx:* 144. SO_2: 94. *CO:* 4. *Particulates:* 16.

To heat our three-storey, four-bedroom house, we burned about 2,000 gallons of No. 2 home-heating oil containing about 0.3 percent sulfur. Although the 80-year-old house is drafty, during the winter we sealed off the top floor and several other rooms. If we used wood stoves for heat, burning 200 pounds of hardwood per winter would create about 1.6 pounds of organics and 32 pounds of CO.

Sources: U.S. Dept. of the Interior, Bureau of Mines; Air Pollution; Perry, Robert H. and Cecil H. Chilton, Chemical Engineer's Handbook.

CAR EXHAUST

Total organics: 9.9. *NOx:* 19.8. SO_2: 6.6. *CO:* 112. *Particulates:* 16.5.

In 1988, we drove our two cars about 15,000 miles. We have a 1988 Ford Taurus that gets 15 to 22 mpg, and a 1983 Toyota Corolla that gets 27 to 35 mpg. Both cars have catalytic converters.

Our cars emitted 45 percent of our organics, 97 percent of our CO, and 43 percent of our particulates.

Sources: Motor Vehicle Manufacturer's Association Atmospheric Chemistry Panel; Perkins, Henry Crawford, Air Pollution, 1974.

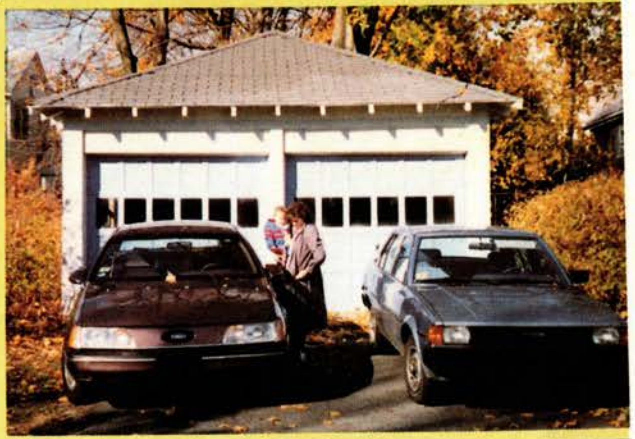
Our Total Air Pollution

(in Pounds)

Total organics: 22. *NOx:* 224. SO_2: 179. CO: 116. *Particulates:* 38.

In gathering this information, we learned that pollutant emissions — at least from our regional waste-to-energy facility — are lower per kwh than from typical power plants burning coal or oil. Compiling this information led me to examine day-to-day choices, and conclude that our family creates less air pollution in disposing of our trash than we cause in other aspects of our lives.

Adapted from an article by Norman P. Getz in Solid Waste & Power, *a trade journal.*



(above left) The house that consumed 2,000 gallons of heating oil. (right) CO-culprits: The Getz' late-model cars contributed 97 percent of the family's total carbon-monoxide pollution.

continued from p. 39

More important is the introduction of electronic ignitions to gas appliances. Not only do these automatic starters bring a 25- to 50-percent energy savings for just a small increase in purchase price, but they also eliminate the pollutants generated by the continuous gas flame. An electronic ignition is required in the U.S. in all gas stoves manufactured after January 1, 1990. It should be mandatory in your kitchen, too. Some people have the pilot lights in conventional stoves turned off. This should be done only by a qualified person; some utility companies will do this for free or for a nominal charge.

If you're installing a separate oven, there is no reason to choose a gas oven over an electric model. With an electric oven, the temperature is regulated more constantly. Additionally, unless there is an electronic ignition with a gas oven, the pilot light can account for 40 percent of the oven's gas usage. Because of gas-combustion emissions, I strongly believe that the only suitable gas ovens are those with their own venting systems. If you already own one that is not self-venting, be sure to provide adequate ventilation. Also do not forget that well maintained and adjusted burners have less gas emissions.

A door window and a light are a food- and energy-saving combination: Visibility eliminates the need to open the door frequently to check on the food's progress. Each time the oven door is opened during cooking, a loss of 25° to 50°F or more occurs.

Despite their obvious attraction, continuous-cleaning ovens should be avoided, as the wall coating may dissipate into the air. Also, according to *Cook's* magazine, the specially coated walls are "generally ineffective" and then can't be treated with abrasive cleaners. Others say the feature doesn't really clean but merely "degreases." Future models may have glass-ceramic walls that clean better and do not dissipate into the air.

I would not spend my money on a self-cleaning oven either, one reason being the extra expense involved provides a very dubious return. (The self-cleaning feature can add up to 21 percent to your operating costs, and ovens are not used enough for the savings from extra insulation to amount to anything.) Although they may eliminate the need for strong oven-cleaning chemicals, the self-cleaning process can produce airborne pollutants while in operation.

Remember that the smaller the oven is, the more efficient. It makes little sense to heat up an entire oven just to bake one potato. Here, a toaster oven or other small countertop oven would be much more sensible. According to *Good Housekeeping* magazine, it takes approximately 0.52 kilowatt-hours to bake potatoes in a toaster oven, compared with 1.67 kilowatt-hours in a conventional electric oven and 1.22 kilowatt-hours in a self-cleaning electric oven. Thus, a well-thought-out kitchen might have at least two, and possibly three, ovens of varying sizes.

• COLLECTING COMPOST

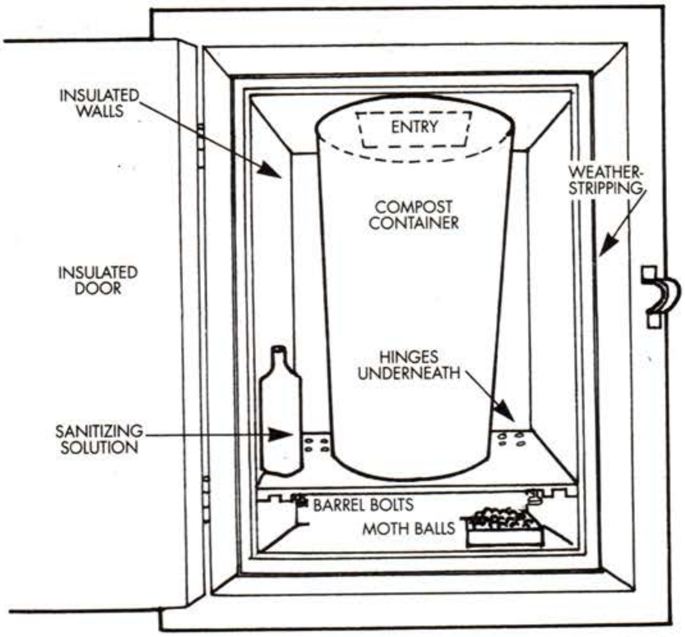
I suspect that the most difficult part of the composting process for many people is the odor of accumulated food waste and the insects that are inevitably attracted to it. I was determined, therefore, to design and build a system that would make saving food scraps more convenient.

I designed a receptacle for peels, bones, vegetables tops, and spoiled food that remains "in" the kitchen but outside of the house. The food waste should be dumped in a plastic garbage can that rests under a corner of a counter that abuts an outside wall. A corner is an excellent location, as the space usually goes to waste anyway.

I boxed in the designated compost cabinet from the rest of the cabinet and insulated it. I had an access door from the outside fabricated and installed. This door must be well made and tightly fitted — weatherstripped and secured with a sliding bolt. Do not put a vent in it or you will attract dogs, raccoons, and other scavengers. Make sure the outside-door opening is cut so the can has complete clearance. It would be best to insulate the compost cabinet's inner walls with rigid insulation (to R-12).

I cut an entry for compostable wastes into the countertop. Mine is a 6-1/2-inch square with rounded corners. (A round hole would be even better, eliminating hard-to-clean corners.) For hygiene, the cabinet interior has to be lined with plastic laminate, Kortron, or metal. (Don't forget the underside of the counter; it is easier to line it before the counter is installed.) All seams should be well sealed. If the countertop is a plastic laminate, use it to cover the edges of the access hole. In my kitchen, the chosen Corian counter provided a good natural edge. (But make sure the exposed surfaces of any underlayment are protected.) A good epoxy or urethane paint alternately creates a washable surface, but it's not preferred.

To ensure that fruit flies and other insects don't get into the compost container, I hang a flea collar over the edge of the can. It works very well and will not sully the quality of your compost. I also keep a small can of sawdust or wood ashes in a nearby kitchen cabinet. Layering the bottom of the can with one of these odor absorbers and occasionally adding some more to the accumulating compost helps neutralize the smell. A brush and bottle of sanitizing solution is handy for cleaning the can after it is emptied.



Outside view of the compost container, located under the kitchen counter. Sliding barrel bolts hold the platform in place, and are easily removed.

How to Compost Indoors

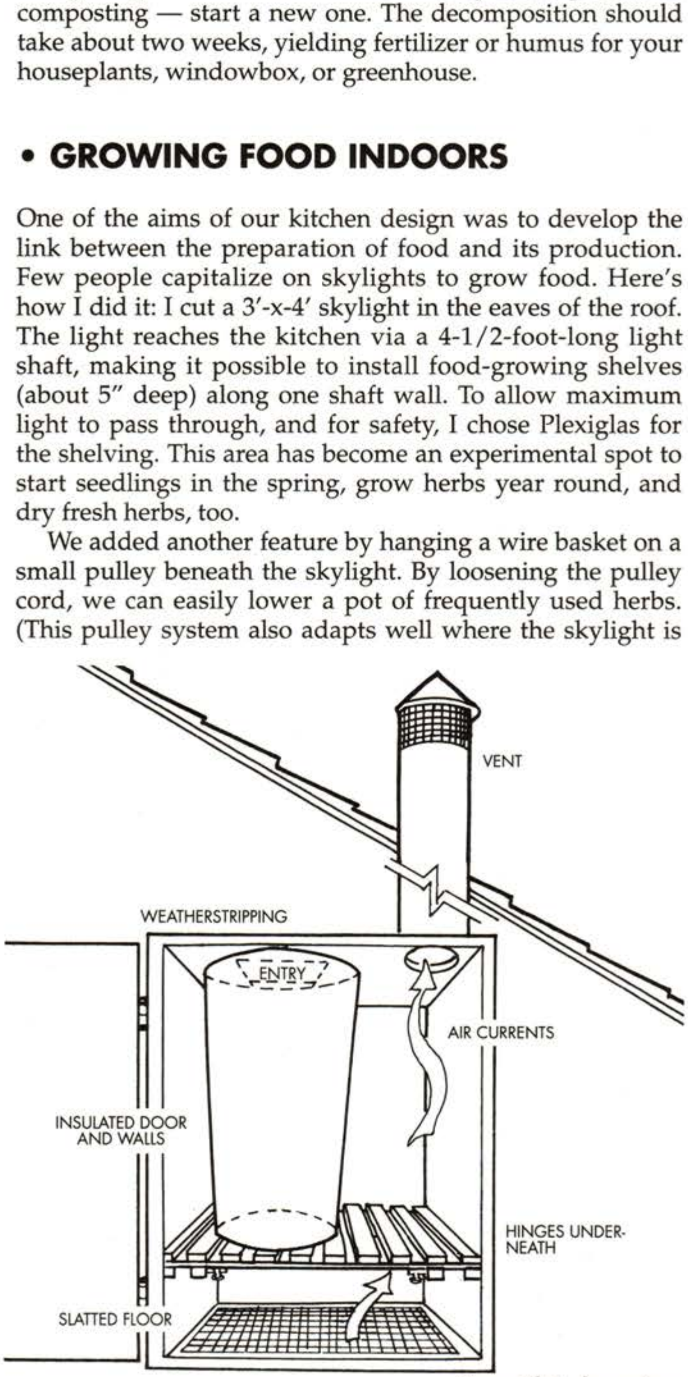
Making compost indoors is like making it outdoors except on a smaller scale. Carolyn Jabs, a writer who uses this technique, suggests composting in either large plastic jugs with the tops cut off, or in any short, wide, waterproof container.

Food wastes should be chopped or pureed in the blender or food processor. Otherwise, compost only foods that are already quite small, such as coffee grounds, tea leaves, and vegetable parings. The wastes should be layered with soil (make sure it is not sterilized), and stirred daily. Small amounts of grass clippings (from a suburban friend) or hay (from a stable) can also be mixed in. It is the mixing and stirring which will kill off any odor-causing bacteria. Keep the mix moist (but not soggy), and do not add garbage to a container that is already in the process of composting — start a new one. The decomposition should take about two weeks, yielding fertilizer or humus for your houseplants, windowbox, or greenhouse.

• GROWING FOOD INDOORS

One of the aims of our kitchen design was to develop the link between the preparation of food and its production. Few people capitalize on skylights to grow food. Here's how I did it: I cut a 3'-x-4' skylight in the eaves of the roof. The light reaches the kitchen via a 4-1/2-foot-long light shaft, making it possible to install food-growing shelves (about 5" deep) along one shaft wall. To allow maximum light to pass through, and for safety, I chose Plexiglas for the shelving. This area has become an experimental spot to start seedlings in the spring, grow herbs year round, and dry fresh herbs, too.

We added another feature by hanging a wire basket on a small pulley beneath the skylight. By loosening the pulley cord, we can easily lower a pot of frequently used herbs. (This pulley system also adapts well where the skylight is flush with the ceiling and shelves cannot be hung, or where other access is too difficult.) If a skylight serves as a growing area, venting is mandatory. Watch for heat buildup on unseasonably warm days.



A ventilated version.

Fixed shelves and hanging pots on pulleys create a skylight garden in the author's kitchen.

Full-spectrum "grow lights" have been specially developed to more closely mimic the sun's natural light. They are available in both screw-in and tube fluorescents. The Vita Lite brand, whose bulbs are said to provide 91 percent of the natural-light spectrum, can be purchased from Vita Lite representatives, or from natural-food and specialty-lighting stores. Full-spectrum bulbs are not a total substitute for natural sunlight; one expert equates 40 hours under one as equal to half an hour of natural sunlight. Full-spectrum lights are used for lighting under the cabinets in my kitchen — another area that can be used to grow herbs and the like on the countertop.

A miniature window greenhouse is another way to make a kitchen more productive. It can hang on the outside of the house over a window in a reasonably sunny spot. A good greenhouse should allow for ventilation within it, but note that it will probably not give you the same amount of room ventilation as an ordinary window does. Skylight suppliers are a retail source of window greenhouses.

Managing recyclables is another article altogether. See "Kitchen Design for Recycling" in the September/October 1989 issue of **GARBAGE**.

First in a series

Common sense would tell you that things ought to be allowed to rot. That using non-biodegradable materials for single-use products on a massive scale would create a disposal problem. That waste which must be burned should be burned as fuel.

Yet our most popular disposal technique of the past decades has been the sanitary landfill, the high-tech successor to the town dump. You may have assumed that landfills operated like giant compost piles — that garbage sent there rotted away. That's not the case; the modern landfill is more a concentrated, anaerobic tomb for mixed wastes which, despite expensive experimentation, leaks hazardous leachate into groundwater supplies, and remains a maintenance nightmare long beyond the generation that built it.

Economics and politics complicate our handling of garbage, but there's nothing particularly difficult on the technical end: reuse of materials ("recycling"), inert storage ("sanitary landfilling"), burning ("incineration," or "waste-to-energy"). We begin our series with the most obvi-

COMPOSTING

From Backyards to Big-Time

For years I've kept a secret. Like most every environmental writer I'm a big believer in the virtues of backyard composting. I've rhapsodized over compost's ability to help heal our chemical-dependent gardens. I've pointed out that composting can keep kitchen scraps and garden debris, which account for an incredible 20 to 30 percent of our trash, out of garbage dumps — excuse me, landfills. I've edited articles on the joys of composting for this very journal. I even bought one of those spiffy, off-the-shelf compost bins ... for my Dad. But I've never made an ounce of compost myself.

It's not that I'm neurotic about billions of microbes decomposing trash, multiplying, and heating up those compost heaps. I'm a gardening addict, love to sink my hands in dirt, even spend money on (other people's) compost. I tell myself my postage-stamp-size yard is too small for a compost pile. And somehow the prospect of sharing my 9'x14' kitchen with a box of manure worms munching on potato peels has never gotten me going.

But the real truth is, I'm just too busy and can't be bothered. I suspect I'm not alone.

The garbage business *knows* I'm not alone. The number of municipalities and private companies getting into composting is beginning to soar. According to *BioCycle*, a magazine that specializes in biological approaches to waste management, last year about a thousand facilities in this country were composting leaves or mixed garden refuse. At eight facilities, amazingly enough, mixed household trash — the kind that comes straight out of your garbage pail — is being composted. With landfills and incinerators on every citizen's most-hated list, these "municipal solid-waste composting" facilities, as they're called, are seen as something of a garbage-management messiah by a growing number of municipal officials.

From July 1989 through March of this year, *Waste Age*, the monthly trade magazine of the garbage business, ran an eight-part solid-waste composting course for its readers. In November, composting was the subject of a Congressional hearing for the first time. In February, the Solid Waste Composting Council, headquartered in Washington, was formed to beef up the fledgling industry's lobbying clout. In April, the Composting Research

ous option of all: letting it rot, or "municipal composting." The compost operations described here can do what the landfill can't — turn not only leaves, not only food waste, but even unsorted household garbage into rich, useful organic matter. Along with recycling of "hard" materials such as glass and metals, large-scale composting is one way we'll get rid of garbage — both the stuff and the very concept itself.

—Patricia Poore

DENNIS BARNES

About 18 percent of our annual trash load is leaf and yard waste — the easiest to compost.

BY JANET MARINELLI

Act, introduced by Rep. George Hochbrueckner of New York and designed to increase the amount of trash that gets composted, was unanimously adopted by a House subcommittee. In May, a similar bill was adopted by a Senate subcommittee, and at press time some form of the two bills was said to have a good chance of becoming law.

What's more, the goliaths of the garbage industry are beginning to take notice. Wheelabrator Technologies Inc. has taken on the license to a Swiss waste-processing and composting technology. Waste Management Inc. was one of the companies that posted job notices and wined and dined compost specialists at *BioCycle's* national recycling and composting conference in Minneapolis in May.

In short, composting is hot.

• RAW POLITICS OF TRASH

Why all the ballyhoo about solid-waste composting?

The big reason, of course, is that landfilling and incineration have fallen out of favor. By now there aren't too many Americans who don't know that landfills smell bad, depress property values, and create leachate, or potentially toxic runoff, and methane gas, which is potentially explosive. By the same token, incinerators (these days called "waste-to-energy facilities" because the burning trash creates steam to run a generator which produces power) have a history of air pollution problems, and once the garbage is burned, there is the pesky problem of how to dispose of potentially toxic ash.

Beyond the raw politics of trash, however, is a simple matter of arithmetic. Ordinary household garbage consists of roughly 25 percent inorganic materials — glass, metal, plastic — and 75 percent organic, or carbon-based materials — food wastes, garden clippings, paper. Most carbon-based materials are readily compostable. And unlike landfilling and incineration, composting not only renders the organic fraction of the waste-stream harmless, but also recycles useful plant nutrients and organic matter which can be returned to the land.

By now you're thinking, if large-scale composting is such a great idea, why hasn't it been done before? It has.

Dr. Clarence Golueke is a microbiologist who conducted the first serious U.S. study of urban-waste composting in the Berkeley, California, dump three decades ago and continued to labor in the field even in the '60s when, in the words of one admirer, he "felt like John the Baptist crying in the wilderness of waste research." Dr. Golueke divides the history of solid-waste composting into three periods. During the early period, from the 1940s to the late '60s, he and others applied the principles of agricultural-waste composting, first developed in the 1930s in India by Sir Albert Howard, to community wastes. But at the time there was plenty of land available for open dumping of garbage, and garbage dumps (unlike today's "sanitary landfills," which are high-tech tombs for trash) were much less expensive than composting. There wasn't much funding for compost facilities to boot, and several ventures were disastrous financial failures. A few poorly managed operations added to solid-waste composting's woes. The upshot was that composting ceased to be regarded as a serious solid-waste management option, except among a few "keepers of the faith," and languished during a dormant period which lasted a good seven or eight years.

In the mid '70s, as clean-water regulations went into effect, more and more communities built sewage-treatment plants, and sludge, the byproduct of removing solids from sewage, began piling up. Incinerating sludge or dumping it in landfills turned out to be less than perfect solutions, so local officials began casting around for alternatives. Today, despite increasing regulation, composting is the fastest growing sludge-management technique. Meanwhile, pollution controls have sent the price of landfilling and incinerating garbage through the roof, increasing the incentive to recycle glass, aluminum, plastics, and other materials — and to compost the organic materials in trash.

In December, the Environmental Protection Agency (EPA) issued regulations which in effect require local officials to recycle 25 percent of their trash if they want to build incinerators. Prodding local sanitation officials are also a fresh volley of state laws to spur recycling. The state of Florida, for example, wants municipalities to be recycling 30 percent of their trash by 1993. In the words of solid-waste consultant Ron Albrecht, "It's hard to reach 25 percent or more with just hard recyclables" — glass, aluminum, other metals — "so there is a vast drive towards solid-waste composting."

• WHAT GOOD IS COMPOST?

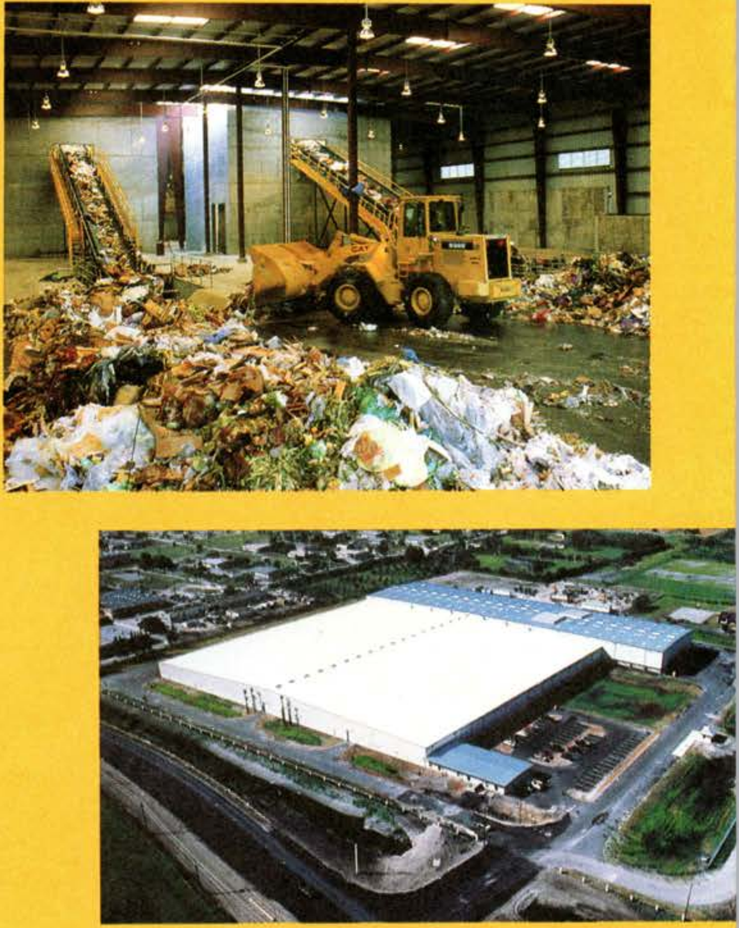
It's been estimated that a plant designed to compost all the organic wastes, garbage, and sludge of a municipality of one million people would produce about 600 tons of finished compost a day. Sure, compost helps promote plant growth. It's a great source of organic matter, which helps soil retain water and hence reduces soil erosion as well as "nonpoint source" water pollution (pollution carried by water running off of farmlands, for example). But multiply 600 by even a fraction of the millions of people in this country and you get a staggering amount of compost. What can you do with this stuff?

Richard Kashmanian, a senior economist with EPA's Office of Policy, Planning, and Evaluation, has been poring through abstruse volumes like the Statistical Abstracts published by the Bureau of the Census in an attempt to answer just this question. Like other proponents of compost, he believes one of the biggest markets for clean, high-quality compost is the American farmer. Soil erosion on U.S. cropland is one of America's most serious environmental problems, causing billions of dollars of damage a year to agricultural productivity and water quality. Two agencies in the U.S. Department of Agriculture alone are supposed to help farmers minimize soil erosion on their lands by providing technical assistance and cash. According to figures Richard Kashmanian has managed to dig up, 65 tons of compost are needed to add one inch of compost to an acre of land. There are 413 million acres of cropland in this country (1.3 billion if you include rangeland and forestland). If USDA were to encourage the use of compost as a soil-conservation measure on only the estimated 25 million acres of American cropland that have the worst erosion problems (that lose more than 15 tons of soil per acre per year), you're talking about a whole lot of compost.

AT AGRIPOST...

Agripost's garbage-to-compost facility outside Miami, the largest in the U.S., can process 800 tons of trash every day.

PHOTOS COURTESY AGRIPOST



Another potentially huge market for compost are the nursery and landscaping industries. According to Richard Kashmanian, 955,000 short tons of peat moss, a source of

(above left) "Pickers" remove oversized objects and hazardous materials. After the garbage is ground to two inches or smaller, it goes to the six-acre indoor composting area, where it decomposes for about a month. Steam rising from a windrow (left) shows the microbes are doing their aerobics. After it's re-ground and screened, the compost is moved outdoors (above right), where piles cool down. Weeks later, finished compost is bagged and shipped to growers, golf courses, and others (right).

(left) The "tipping floor," where garbage trucks dump unsorted household trash. The 20-acre Dade County site, constructed at a cost of $25 million, includes a 320,000-square-foot building.

organic matter used by landscapers to improve soils and by commercial growers in potting mixes, were produced in this country in 1987. Another 515,000 short tons were imported, for a total of 1,470,000 short tons. Compost could easily substitute for peat as a source of organic matter. And the peat figure doesn't include topsoil, fertilizers, and the myriad other soil amendments used in this country every year.

Land reclamation is still another large potential market for compost. The amount of soil and soil amendments needed for various restoration projects, from strip mines to highway construction sites, is prodigious. Consider landfills alone: About 2,000 landfills averaging 9.1 acres or more are expected to close in the next five years, according to the EPA. And these landfills will be covered, or capped, with some two feet of dirt. That's a lot of soil, and soil is not only expensive but often difficult to come by. Compost would fit the bill nicely.

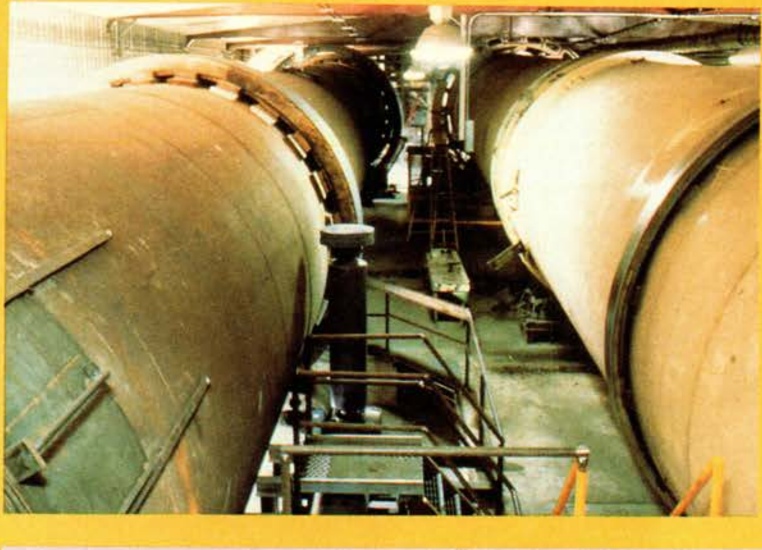
Add sod farms, golf courses, home gardens, municipal parks, rangelands (which also have serious erosion problems), commercial timberlands, and other assorted users of soil products, and as Richard Kashmanian puts it, "The potential for compost is big." The trick is getting compost makers to tailor their products to the different markets. High-nitrogen composts made partially with manure or clean sewage sludge would be best for farmers, for example. Home gardeners want compost that has been screened to remove small pieces of glass, plastic, and stones. On the other hand, those who would use compost for landfill cover or to revegetate construction sites might not be as fussy.

Almost nobody expects composting to make a lot of money for a long time. Clarence Golueke speaks for many experts in the field when he says that "composting is a community service, not a profit-making enterprise." Right now, most public officials are looking for a way to keep wastes out of landfills. About the best they can hope for is that any revenue derived from the sale of compost will help offset the expense of environmentally sound sanitation systems.

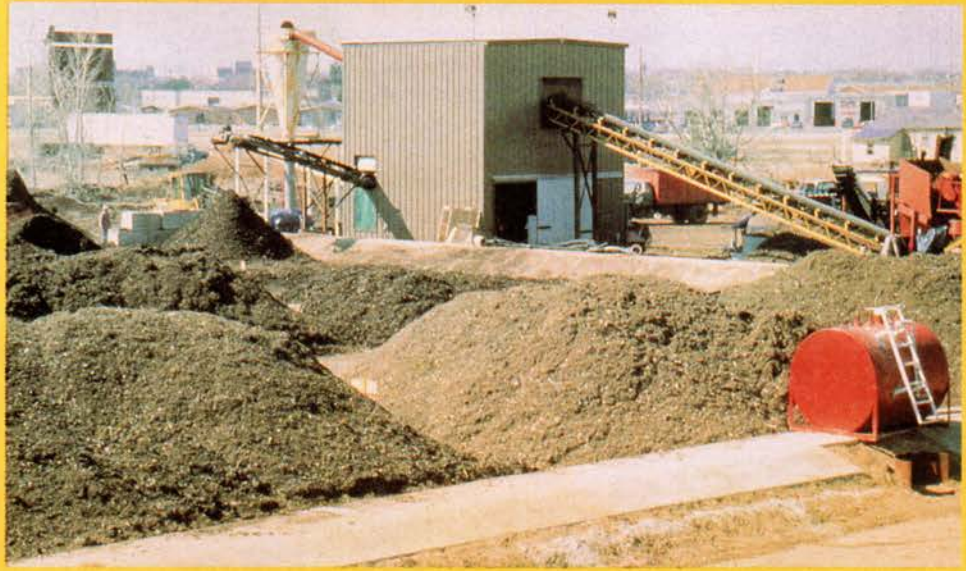
• COMPOST FACTORIES

Recomp Inc.'s facility in St. Cloud, Minnesota, is composting at its most high tech. Garbage trucks arrive and are

PHOTOS COURTESY RECOMP



AT RECOMP...



At Recomp in St. Cloud, Minnesota, household garbage goes into huge digesters (the drums shown above left), and comes out looking like compost three days later.

Then it "cures" outdoors for about three months (left). Cans and stones are removed in the building shown.

Recomp's compost (above) has gone to highway projects and Christmas-tree farms.

weighed. They then pull into the facility and dump their odiferous loads. Recomp gets paid for taking every ton.

Bulky, noncompostable items — furniture, large appliances, rugs — are removed from the heap. After some of the lighter trash, mostly paper, is removed and sent to a local utility where it's burned for fuel, a magnetic separator pulls out batteries, steel cans, and other ferrous metals. The rest of the garbage — fish heads, plastic wrap, shards of glass, disposable diapers — goes into two giant yellow drums, or digesters. Household trash is usually pretty high in carbon, so it must be combined with a high-nitrogen material for the optimal carbon-to-nitrogen ratio for composting, about 20-30:1. (Recomp used to use sewage sludge but is now using urea fertilizer.) In the slowly turning drums, the carbon-to-nitrogen ratio, temperature, and moisture are carefully controlled, and decompostion occurs rapidly.

Writer Gene Logsdon has described composting as "Microbes at the dining table of life, eating and being eaten..." Bacteria, fungi, and actinomycetes, microscopic plants that decompose organic matter, are the most important composting organisms. They eat the carbon, converting it to carbon dioxide, water, and humus (the portion they can't digest). Nitrogen is the other major microbial nutrient. In the process of dining on the garbage, the microbes grow and reproduce. All this activity makes the pile heat up, killing organisms that are harmful to plants and animals.

The humic byproducts resulting from the digestion of one type of organism becomes the food source for another type. This chain of succession of different types of microbes continues until most of the biodegradable material has been consumed. At this point, what's left is called compost. It's made up largely of microbial cells, microbial skeletons, partially decomposed particles of organic matter, and inorganic particles (glass, sand, rock).

St. Cloud's garbage emerges from the digesters three or four days after it goes in. Once it's screened to remove large uncompostable pieces, it looks and smells a lot like soil, and has no more harmful bacteria than fresh cow manure. For about another four months, the compost cures outside in windrows, or long piles, further killing off harmful pathogens to a level no greater than ordinary backyard dirt. At this point, depending on the market for which it's intended, the piles of brown loam are screened again and glass and stones are removed. It can even be combined with other materials to make "designer" composts. Some of the experimental products that have been manufactured from the trash that went into the giant yellow drums: an "ultralight" potting medium for hanging plants made from sanitized and ground-up plastic diaper liners (Procter & Gamble, the maker of Pampers, recently funded a study that demonstrated that Recomp's digesters can turn diapers into compost), a fungus-fighting compost for golf courses, and a cactus-grade mix made with ground glass.

About 100 tons of trash a day from 100,000 area residents are routed to Recomp's digesters. About 30 tons of this are noncompostable materials that end up at a landfill. Forty to 50 tons of compost are produced a day (the remaining 20 or 30 tons dissipate as carbon dioxide or water vapor). Of the three ways St. Cloud's trash is "managed" — composting, landfilling, or incineration — composting is the cheapest, according to Recomp's Bill Healey. Recomp sells its compost for use by landscapers, in highway projects, and at Christmas-tree farms. It's also being used quite successfully to reclaim mine sites in northern Minnesota.

Compost's success ultimately hinges on whether it is clean enough to be useful. And there is some heated debate about what ends up in compost made from the grimy confetti of society's leftovers which ends up in our garbage pails.

Recomp spent three years refining a system that screens batteries and other potential carriers of lead, mercury, and other heavy metals out of the wastestream — and hence out of its compost. The batteries are sent to a hazardous-waste facility for safe disposal. Until recently, workers called "pickers" also plucked aluminum cans, bottles, plastics, and other recyclables from the trash before it proceeded to the digesters. After months of testing, the St. Cloud facility is now a commercial facility, meaning it sinks or swims on the amount of money it makes. And for the time being at least, Recomp has decided there's no profit to be made in hand-picking materials out of St. Cloud's garbage for recycling.

Recomp's Bob Olson told me that most metals are removed by various separators and screens at the St. Cloud facility, ensuring that Recomp's compost is safe. The latest analyses confirm this. The screens also ensure that the compost is relatively free of plastic chunks and other unsightly debris.

• THE GREEN-WASTE OPTION

Agripost Inc., the operator of an even more ambitious operation designed to compost 800 tons a day of greater Miami's garbage, has also decided that pulling out recyclables is not worth the effort. At the Dade County, Florida, facility, which was recently fired up, household trash is visually inspected for lead-acid batteries, propane tanks, and other potentially toxic materials. The rest of the trash — glass, plastic, metals, and other recyclable materials included — goes through a two-stage grinding process, where most of it gets pulverized and ends up in the finished compost.

Dave Smith, vice president of Agripost, points to studies demonstrating that "Agrisoil," the company's compost, is safe. He says there aren't a lot of heavy metals in household garbage. And as for the tiny pieces of glass, metals, and plastic in Agrisoil, he says commercial potting mixes often contain more than 50 percent inorganic ingredients such as sand, perlite, and vermiculite.

Nevertheless, many environmentalists and compost scientists suspect that composting without careful screening out of recyclables and hazardous household wastes virtually guarantees high levels of heavy metals in the finished product, limiting it to only one legal use — disposal in the very landfills it was designed to avoid. Studies in Europe, where municipal solid-waste composting is more common, confirm these suspicions. According to the Congressional Office of Technology Assessment, for example, municipal solid-waste composting has declined in Sweden, where it was once prevalent and actively promoted, because of problems with heavy metals. The Europeans have also found that compost produced from the co-composting of mixed solid wastes and sewage sludge, itself often a source of toxic metals (mostly from industrial operations hooked into the sewage system), contains even higher levels of metals and other contaminants.

Other studies in Europe and the U.S., on the other hand,

What good is compost? Commercial growers are a huge potential market for it.

DENNIS BARNES

COMPOST DICTIONARY

Aerated static piles — A composting technique in which garbage is formed into piles that are mechanically aerated. The piles are placed over pipes which are connected to a blower that supplies air for the aerobic (oxygen-loving) organisms that turn wastes into compost. The controlled air supply makes possible the construction of large piles, decreasing the amount of land needed.

Co-composting — The composting of two or more wastes with different characteristics together. This most often refers to composting sewage sludge with garden clippings or mixed trash.

Curing — The final phase of composting. Microbial activity continues, but at a slower rate. As the compost cures, less heat is generated by the microorganisms, and the pile begins to cool down. Curing can take from several days to months.

Green wastes — Garden and food wastes, which when composted together produce a clean, high-quality compost.

In-vessel composting — High-tech composting. Garbage goes into a chamber or vessel, usually a drum, silo, or digester. Because mixing, aeration, temperature, and moisture can be tightly controlled, this is the fastest form of composting, and consequently requires less land than other technologies. What's more, since they're enclosed, these operations tend to have fewer odor problems and produce little or no leachate, or polluting runoff.

Municipal solid-waste composting — The bureaucratic term for large-scale composting of the organic portion of what goes into our trashcans. About 75 percent (by weight) of ordinary household garbage is organic, or carbon-based, and therefore compostable. However, there is an argument to be made that recycling some of these materials — turning old newspapers into recycled newsprint, for instance — is more energy- and resource-efficient than composting them.

Solid-waste composting — Composting of leaves and other garden clippings, food scraps, paper wrappers, and other biodegradable material in ordinary household trash (as opposed to, say, sewage sludge and industrial and agricultural wastes).

Windrow composting — A windrow is a long pile, roughly triangular in cross section, usually about seven feet high and 14 to 16 feet wide at the base. Solid wastes formed into windrows for composting are turned by machines equipped with augers, paddles, or tines as frequently as once a week to provide aeration for the aerobic (oxygen-loving) composting organisms. Turning the piles also moves materials at the surface of the windrow into the center, where they decompose rapidly. Generally, windrow composting takes longer than any other method and requires the most land.

suggest that if recyclables are pulled out of the waste stream, heavy metals in compost should not be a problem. This is enough to make believers of officials in the 78 localities where, according to *BioCycle's* annual survey The State of Garbage in America, mixed solid-waste composting facilities were either under consideration or in the works last year. Other communities are taking a wait-and-see attitude toward mixed solid-waste composting.

Not so for leaf- and yard-waste composting. Most local officials would agree with the Wisconsin public works director who says people would think him crazy if he required every homeowner to dig a giant hole, line it with five feet of compacted clay, and install a leachate collection system — in other words, construct a miniature version of a modern landfill — all to provide a place to dump leaves and grass clippings. However, even in Northern states, that's just what comprises as much as 20 percent of what goes into landfills.

New Jersey, Florida, Minnesota, and seven other states have already banned the disposal of either leaves alone or all types of yard waste in landfills or incinerators. From 1988 to 1989, the number of facilities composting leaves and yard clippings jumped about 66 percent; there are reportedly more than 100 facilities within 50 miles of Philadelphia alone. Also increasing are the number of operations that co-compost leaves and garden clippings with high-quality (low in metals) sewage sludge.

But what about all those pesticides Americans love to scatter and spray in their gardens? Don't they end up in the compost? Several studies suggest that many pesticides break down during composting. In a recent study of compost produced from leaves collected in Croton-on-Hudson, about 20 miles north of New York City and probably as heavily blitzed with pesticides as any affluent suburban community, Tom Richard of the Department of Agricultural and Biological Engineering at Cornell found that pesticide residues weren't a big problem. Only four pesticides were detected in the finished compost, and they were all at the low end of the range one would expect to find in typical suburban soil. These included a number of byproducts of the decomposition of chlordane, once used for termite control but banned in 1988 — a good sign that the chlordane is breaking down and can be expected to decrease even further in the future.

Many of the same compost proponents who advocate a go-slow approach to composting mixed municipal garbage believe local officials should accelerate efforts to compost so-called green wastes — leaves and other garden clippings plus food wastes. Composting of yard and food wastes that have been separated from the rest of municipal trash is increasing in Europe, according to the Office of Technology Assessment. In 1988 in West Germany, for example, there were at least 71 different green-waste collection systems serving an estimated 430,000 households and composting some 200 pounds per person of organic wastes each year.

• THE OLFACTORY FACTOR

There's one thing everyone wants to know about compost facilities — do they smell? Well, make no bones about it: Decomposition does have a rather distinctive odor. But then, smell is a pretty subjective thing. As a friend and former compost fanatic put it, "The pungent aroma of decomposition — tinted with ammonia, sulphur, musk, and wet dirt — is delicious to the devotee...."

I can only tell you first-hand about the two composting facilities that I've visited. One was a leaf- and yard-waste operation which smelled pleasant, kind of earthy. The other was Recomp's St. Cloud facility. The Recomp people are doing an impressive job of turning grimy garbage into usable compost. But believe me, there were times I thought I was gonna gag.

The folks at Recomp are quite upfront about their odor problem. Part of the odor problem, says Bob Olson, can be traced to the "tipping floor," where the garbage is dumped. This smell, kind of like rotten apples, has nothing to do with the compost operation *per se*, but rather is common at any garbage transfer station.

Recomp suspects most of the odor emanates from the curing area outdoors. A consultant is studying a range of remedial steps that can be taken, from enclosing the area to investing in more efficient equipment to turn and aerate the windrows.

According to most composting experts, odor problems at composting facilities are common — and manageable. They say odor control is largely a function of carefully controlling the temperature and moisture content of the compost piles, as well as of regular turning of the piles to prevent them from becoming anaerobic (anaerobic decomposition, which is accomplished by microorganisms that don't require oxygen, smells a lot worse than the aerobic variety).

Enclosing the facilities can also reduce the smell, and some facilities even use sophisticated filters to deodorize the air inside. Of course the simplest solution is to put the facilities as far from residential neighborhoods as possible; if Recomp weren't inside the St. Cloud city limits, for instance, it wouldn't need to go to such elaborate lengths to deodorize the operation.

Assuming odors can be kept under control, how does solid-waste composting fit into the garbage management "mix"? Yard-waste composting makes obvious sense, and is already becoming a widely accepted trash-management technique. And, perhaps someday soon, we Americans can be prodded into separating our food scraps so it can be collected with garden clippings and other recyclables. As for composting mixed garbage, the jury is not yet in. But the potential benefits to the environment are so big, I for one am glad some forward-thinking communities are willing to give it a try.

If hazardous wastes can be safely weeded out of household garbage (better yet, if we Americans can be coaxed into using fewer toxic products to begin with) ... if designers can be cajoled — or bullied — into removing cadmium, lead, and other toxins from everyday packaging (and hence keep them out of compost) ... if the use of nonrecyclable and nonbiodegradable materials in products and packaging can be kept to a minimum ... if metals, glass, and other recyclables are removed from the wastestream before composting begins — big ifs — then mixed solid-waste composting can be a key part of a garbage-management system, or, more to the point, a resource-management system, in which all materials are either recycled or safely returned to the soil.

PHOTO COURTESY FARMLAND TRUST

Soil erosion on farmland is one of our most serious environmental problems; high-quality compost can help reclaim these lands.

JOGGING THROUGH THE SMOG

by Ginia Bellafante

On a weekday afternoon in June, the East Coast is blanketed with a yellowish-brown haze. Powered by a high-fiber lunch, Peter Seterdahl, a former collegiate rower, mounts his racing bike for a-20-mile spin through New York's Central Park. He weaves through rush-hour traffic, gulping air laced with carbon monoxide, nitrogen oxides, and sulfur dioxide, all contributors to urban smog. Admittedly, he feels a lot better during his long weekend rides in rural Long Island. "I breathe deeper more easily where the air is cleaner," says Peter. "I just don't have to work as hard."

On the same day, outside smoggy Los Angeles, Kesa Tsuda and Clayton Steffensen set out for a six- and nine-mile run, respectively. Kesa takes to the boardwalk on Hermosa Beach. Clayton plunges into the car-clogged streets of the San Fernando Valley. Kesa has run in five Boston Marathons. Clayton hasn't missed more than four days of running in the past six years. Both have processed more than a fair share of polluted air. "You can see it and smell it," says Kesa. "Sometimes, you can see a brown layer over the ocean because [the smog] blows offshore." Clayton argues that you don't have to *see* the gloomy haze to realize that the air is bad. "When it's smoggy," he comments, "you can feel a tightness in your chest." Nonetheless, Kesa and Clayton don't let the heavy air hamper their running routines. They are commited to their regimens, even when pollution is a given.

Like many of us, Peter, Clayton, and Kesa cycle and run in smog because they value the benefits associated with regular aerobic activity. They know that exercise promotes respiratory and cardiovascular health, relieves stress, and keeps their bodies lean. Yet each year, about 13 million Americans breathe unhealthy air as they jog, swim, cycle, and compete in sports, according to the Office of Technology Assessment, a research arm of Congress. To what extent does the smog that permeates most of our nation's metropolitan areas degrade our health even as we work so hard to improve it? Certain pollutants, like ozone and acid aerosols, impair exercise performance, and may contribute to the development of serious respiratory ailments.

• WHEN THE AIR WENT BAD

Air pollution is nothing new. In the U.S., it got serious with the Industrial Revolution, when fossil fuels, particularly coal, fired factory turbines and furnaces. Increasing urbanization and industrial growth have created a complex web of new air-pollution problems in ever-growing quantities. According to the American Lung Association, factories, power plants, automotive vehicles, and household chemicals yearly spout 200 million tons of gases and particulates (a mixture of pollutants in solid form) — many irritant or toxic — into the atmosphere.

Many of the chemicals that pour daily into the air react with sunlight to form ozone, a potent pollutant that doubles as the primary component of smog. (Ozone at ground level should not be confused with ozone in the upper levels of the stratosphere, which protects the Earth from the sun's ultraviolet rays.) Because it is ubiquitous, and because it can cause breathing difficulty and a loss of elasticity in the lung, environmental-health specialists deem ozone one of our most worrisome pollutants. The gas is formed in the atmosphere when the sun heats nitrogen oxides (generated by automobiles, fossil-fuel utility plants, and factory-fuel combustion) and hydrocarbons (volatile organic compounds emitted from refineries, chemical factories, paint and coating operations, and automobiles). Ozone pollution peaks during warm weather, often at mid-day when the sun is hottest.

Other pollutants that raise health concerns are carbon monoxide from car and truck exhaust, and acid aerosols — solid particles created in the atmosphere from acid compounds like sulfur dioxide (a byproduct of coal burning). Carbon monoxide can impede exercise performance; acid aerosols, some researchers suspect, may contribute to the development of chronic bronchitis.

Legislative efforts to cut air-pollution levels have met with mixed success. Congress tackled the problem when it passed the Clean Air Act of 1970 and strengthened it with subsequent amendments in 1977. In part, the legislation set new standards for reducing pollutant emissions from industry and automobiles. It mandated standards for air pollutants, requiring the federal Environmental Protection Agency (EPA) to set safe levels for priority pollutants: ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, lead, and fine particles. For example, ground-level ozone should not exceed 0.12 parts per million (ppm) for more than a one-hour average on any single day of the year. The agency fixed the carbon-monoxide standard at 9 parts per million for a period averaged over eight hours. The daily standard is not to be exceeded more than once a year, either. Acidic aerosols are not regulated, despite concerns among environmental-health specialists about their harmful effects.

As a result of the clean air legislation, most major pollution levels fell by as much as 96 percent (see Garbage Index, page 26). The nation's air has become much freer of lead, sulfur dioxide, and soot. Yet despite the regulations, in many parts of the country the air is still unacceptably dirty. One hundred and one cities, containing about half of the nation's population, failed to meet the EPA ozone standard between 1986 and 1988. Nationwide, overall ozone levels rose 14 percent above those of 1988. In the summer of 1988, when steamy temperatures spurred record-high concentrations of ozone across the country, supposedly pristine communities in rural Maine and Vermont encountered readings typical of those in smog-plagued Los Angeles.

ILLUSTRATION BY BATTON LASH

• RUNNING, CYCLING, SWALLOWING DIRTY AIR

Ironically, the decline in the nation's air quality dovetailed with the fitness boom. As blue summer skies turned brown with grime and soot, growing numbers of runners and cyclists were taking to city streets, believing that exercise in bad air is better than no exercise at all. Now, new studies show that polluted air impairs exercise performance. Environmental-health specialists aren't telling joggers to take the summer off, but some warn that daily, strenuous exercise in our most polluted cities *may* lead to long-term respiratory problems.

The number of people affected adversely by pollution could escalate if air quality continues to worsen. Currently, researchers and physicians are studying how pollution – and specifically ozone pollution — compromises the physical performance of those who exercise.

Scientists are learning that fitness enthusiasts are particularly vulnerable to pollutants. The reason? During exercise we take in more air — and consequently more pollutants — than we do at rest. Exercisers are like "vacuum cleaners" that draw in dirty air, states Dr. Edward Avol, director of the aerosol-chemistry laboratory at Rancho Los Amigos Medical Center in Downey, California. The more rigorous the exercise, the greater the number of pollutants introduced into the lungs. When sedentary, we inhale about five to ten liters of air per minute. But while exercising at "target heart rate," or 60 to 85 percent of maximum heart rate (target heart rates vary with age), we take in upwards of 60 to 100 liters of air per minute. An endurance athlete may process as much as 15-20 times more air than he takes in at rest.

> **"We've considered the very young and very old to be high-risk populations (for air-pollution harm). We've overlooked healthy, outdoor exercisers."**
>
> **DR. EDWARD AVOL**
> **RANCHO LOS AMIGOS MEDICAL CENTER**

Moreover, breathing forcefully draws pollutants deep into the lungs, where they can damage sensitive tissue. During the course of an exerting workout, our "breathing route" will more than likely switch from the nose to mouth. (Determining when this occurs is entirely dependent upon individual fitness levels and the duration of an exercise session. For example, a highly trained athlete won't need to breathe through his mouth as readily as someone unaccustomed to exercising aerobically.) Pollutants that would ordinarily be scrubbed via filtering mechanisms in the nasal passages instead pass directly into the lungs. About 90 percent of the ozone we inhale during exercise is not expired.

Such findings have prompted the medical community to consider the air-pollution health risks to the very healthy. "Historically, we've considered high-risk populations to be the very young, the very old, and those with pre-existing respiratory diseases," says Dr. Avol. "Recently it's come to light that we've overlooked healthy outdoor exercisers." Some healthy people observed in ozone-exposure studies demonstrated a greater sensitivity to the gas than others. Scientists cannot yet explain this.

• IT TAKES YOUR BREATH AWAY

Scientists have determined that once in the body, ozone often attacks cell membranes. While human-based lab studies have given researchers a reasonably sound understanding of ozone's short-term effects, information on possible chronic repercussions has been extrapolated largely from animal studies, and is therefore less conclusive. Although scientists can only speculate on the long-term effects of ozone exposure, they believe it leads to the sort of cell, tissue, and bio-chemical changes that *could* pave the way for serious respiratory illnesses such as pulmonary fibrosis and emphysema.

Scientists can say with certainty that inhaling ozone for several hours at EPA-standard levels, or for even one hour at higher levels, can result in "decrement in lung function." Translated, the clinical term means that breathing becomes more difficult and symptoms such as coughing and chest pain may arise. After vigorous excercise, like running or cycling in ozone-laden air, people usually can't exhale as much air as quickly as they could prior to exposure. Of course, they can't inhale as much air, either. Why this occurs is something of a mystery. According to Dr. Howard Kehrl, an inhalation toxicologist at the EPA, one theory

holds that ozone stimulates neural components in bronchial airways, which send a signal to the brain saying, "Don't take a big breath."

The first 30 to 45 minutes of exercise in ozone-heavy air can cause coughing, labored breathing, and chest pain. Dr. Avol reports that some of the subjects he's observed complain that after exercising in air with ozone, they feel as though someone is standing on their chest. "If you're exercising for an hour and a half on a smoggy day," he cautions, "you're likely to feel such an effect for several hours."

In two- and six-hour exposure tests to ozone levels slightly above, at, and below the national standard, researchers are finding significant declines in lung function. In a 2.5-hour EPA test, six groups of healthy young men performed moderate treadmill exercise during four, 15-minute intervals. Each group was subjected to either clean air or to some concentration of ozone-imbued air. Lung-function decrement occurred when ozone was as low as 0.18 ppm, a level found all too often in the real world. Participants complained of coughing at every level.

The EPA also examined ozone effects on exercisers who worked out moderately for six, 50-minute intervals during 6.6-hour periods. When subjected to air containing 0.12 ppm ozone, lung function decline for the whole group fell by 12.3 percent. At presumably safe, lower-than-standard levels (0.10 and 0.08 ppm), researchers discovered that the lung's working capacity diminished after each successive exercise, suggesting that the effects of the pollutants may accumulate during longer periods of exposure.

Kesa Tsuda would have to concur with the EPA's findings. Smog affects her most severely when she's been active for long periods. "Sometimes, I'll be outside all day, running, biking, and swimming," she says. "In the evening I can barely breathe. It's at night when it really hits you."

Competitive athletes may have even more reason to steer clear of ozone, according to a UCLA study that measured how "elite" cyclists performed under the simulated conditions of a smoggy summer afternoon. Over several days, with indoor temperatures hovering around 90 degrees, cyclists on stationary bikes pedalled at 70 percent of their maximum heart rates. Each day, the cyclists were exposed either to clean air or to ozone-laden air (at or above the EPA 0.12 parts-per-million standard). After one hour of riding time, resistance on the bikes was turned up, and the cyclists pedalled until they gave out. When ozone levels in the chamber equalled a first-day smog alert (0.2 ppm), cyclists were exhausted far sooner than when they were breathing clean air. All 17 participants experienced either painful breathing, coughing, chest aches, or a combination of symptoms. Ten of the 17 reported similar symptoms when ozone levels equalled the EPA standard.

When steamy temperatures spurred record-high concentrations of ozone across the country, rural Maine and Vermont encountered readings typical of those in Los Angeles.

Adapting to Polluted Air

Ozone exposure's immediate effects — decreases in lung function, discomfort, and reduced physical performance — are temporary: Total lung function is usually restored within 24 hours after exercise. Nevertheless, environmental-health specialists are concerned that episodes of repeated exposure may weaken the respiratory system's restorative mechanisms and accelerate aging of the lung.

Other researchers are finding that the respiratory system may be capable of adapting to the short-term effects of ozone exposure. During five-day exposures to ozone, people who experience breathing difficulties the first day generally experience the same symptoms more severely on the second day. However, on the third day, symptoms tend to level off. Oddly enough, on the fourth or fifth days, many subjects report no discomfort whatsoever. While some experts believe that we can sometimes acclimatize to ozone's most immediate effects, they have not yet determined if the body can build up a *long-term* tolerence to ozone. Short-term responses to ozone may be accompanied by longer-lasting — and possibly hazardous — bio-chemical effects that researchers can't yet recognize.

Because scientists have a long way to go before charting the full range of bio-chemical changes associated with ozone exposure, they are concerned that people in highly

polluted cities like Los Angeles and New York will "adapt" and imperil their health. In the absence of labored breathing and other debilitating symptoms, active people will continue to exercise outdoors during dangerous ozone highs, doctors believe.

Based on some experiments, we do know that repeated exposure to ozone can spur certain cell, tissue, and biochemical changes that may lead to chronic respiratory illnesses. For example, EPA and University of North Carolina-Chapel Hill scientists extracted bronchial fluid from 11 men who performed heavy treadmill exercise for four, 15-minute intervals while breathing filtered air mixed with concentrated ozone. When researchers examined the participants' bronchial fluid, they discovered a considerable increase in the number of inflammatory cells and enzymes.

No one will say unequivocally that exercising in a polluted world is worse than not exercising at all. Nevertheless, the constant intake of ozone, carbon monoxide, and acid aerosols may force the athlete into early retirement.

Such *chronic* inflammatory and bio-chemical changes may eventually lead to pulmonary fibrosis, a stiffening of the lung. This potentially fatal illness results from the increased presence of collagen, a fibrous protein. One theory has it that respiratory-cell membranes damaged by ozone draw prostaglandins (naturally occurring hormone-like substances) into the lung, which in turn attract collagen depositors. Emphysema, the decay of the lung's delicate air sacs, is another worst-case scenario that could stem from chronic lung inflammation. The EPA study also found that epithelial tissue in the lining of the lung can become more porous after ozone exposure. This "leaky" tissue could make for easier passage of other inhaled toxicants into airways.

Outrunning Auto Emissions

How often have you seen joggers bobbing along traffic-snarled highways and wondered whether they were outrunning the carbon-monoxide fumes? The American Lung Association reports that a half-hour workout in an area polluted with car exhaust produces as much carbon monoxide in the blood as smoking a pack of cigarettes in one day.

Carbon monoxide (CO) does not directly threaten lung tissue the way that ozone does. Nevertheless, it slows the body's ability to distribute oxygen — the primary reason exercisers should stay as far away from carbon monoxide sources as possible. Oxygen-transporting red blood cells prefer carbon monoxide molecules to oxygen molecules; in fact, red blood cells bind 200 times more readily to carbon monoxide than to oxygen. As a result, "Those organs and exercising muscles with the greatest oxygen needs are left the most vulnerable," says Dr. Jonathan Samet, a spokesman for the American Lung Association.

Studies that examined the effects of carbon monoxide on exercise performance supply the expected results: It impairs maximum exercise performance and tires the jogger more readily. Experiments on the health effects of carbon monoxide typically subject CO-laden air to participants engaged in vigorous treadmilling or cycling. Researchers analyze the subjects' heart rates and blood samples. They've found that when as little as four percent of red blood cell-based hemoglobin is "attached" to carbon monoxide, partipants have to work harder and exhaust themselves more quickly.

Like ozone, acid aerosols directly threaten the respiratory system, even though they aren't regulated by EPA clean-air standards. (Different acids from a variety of sources combine to form acid particles. Studies have focused on *sulfuric* acid particles.) A jogger who exercises when air quality is poor inhales acid droplets that deposit on the surface of the lung's conductive airways. Daily one-hour sulfuric-acid exposures in rabbits in a New York University Medical Center study revealed changes in lung structure associated with the development of chronic bronchitis. "It is highly likely that humans would also [develop the same reaction] if similarly exposed," says Dr. Morton Lippmann, professor of environmental medicine and director of the study.

For the most part, lab-generated information doesn't address the real-world problem of pollutant combination. Unfortunately, researchers have made little headway in determining how atmospheric chemical interaction may injure our health. However, a study at New York University Medical Center which monitored the impact of ozone on summer campers in upstate New York revealed lung-function decrements 75 percent greater than those observed in a similar six-hour chamber analysis. This led researchers to believe that pollutants in addition to ozone were responsible for the greater dysfunction in the outdoor study.

The little research that has been completed in the area of combined-pollutant exposure concentrates on the coupling of acidic aerosols and ozone, because they frequently exist together in the atmosphere. Ongoing work at the University of California—Irvine suggests that chronic lung inflammation results from exposure to the combination of acidic aerosols and ozone, rather than from exposure to ozone alone. Some scientists speculate that the potent acid/ozone combination plays a big role in inducing changes that lead to fibrosis. But experts acknowledge that more research is needed.

• AN EXERCISE IN COMMON SENSE

All told, no one will say unequivocally that exercising in a polluted world is worse than not exercising at all. In fact, some experts like Dr. Richard Schlesinger, professor of environmental medicine at New York University Medical Center, believe that "in the long run, [the] effects of pollutants aren't going to counteract the benefits of exercise." Nevertheless, exercising when the air quality is poor may impair performance. And some scientists believe that the constant, voluminous intake of ozone, carbon monoxide, and acid aerosols may force the athlete into early retirement. The question is not whether we should exercise, but *when* we should exercise. Most environmental-health specialists will tell you that it's foolhardy to work out when pollution is at its height. Here are steps you can take to minimize the health risks associated with exercising outdoors:

- **Try to work out before early morning rush hours.** By midday, and often through late afternoon, ozone levels can run four or five times higher than morning levels. Remember that car and truck exhaust combines with heat and sunlight to form the perfect ozone recipe.

- **Be aware of the daily pollution concentrations when you exercise.** In cities and towns populated by more than 200,000 people, a Pollution Standards Index (PSI) or Air Quality Index (AQI) scaled from 0 to 300 is issued each day. Pollution-control officials calculate the figure based on the highest concentration of the EPA priority pollutant present in the air that day. (Numbers correspond to the pollutant level measured in parts per million.) The index figure is available to the media, so check newspapers and TV weather reports for coverage. Pollution levels often can be predicted for the following day.

The American Lung Association reports that a half-hour workout in an area polluted with car exhaust produces as much carbon monoxide in the blood as smoking a pack of cigarettes in one day.

Many cities also maintain pollution-level information lines that update concentration readings every few hours. These updates are useful because ozone travels downwind from its source; towns outlying urban ozone epicenters may experience peaks late in the day. Information lines will also give you readings for specific pollutants not reflected in the day's index. Until there's an acid-aerosol standard, the ppm figure for particulates or sulfur dioxide is the best barometer we have for atmospheric-chemical levels.

The American Lung Association recommends limiting vigorous exercise when the PSI exceeds 100. (Children, and poeple with lung disease are especially vulnerable to ozone above this level.) Shorten your exercise time or switch to moderate activity, such as walking or gardening. At 200 (a figure corresponding to 0.20 parts per million of ozone in the air), pollution is a serious health concern. Outdoor activity should be avoided.

- **Alternate between indoor and outdoor activity during smog season.** There's still a lot we don't know about the ramifications of repeated, concentrated exposure to ozone. If you engage in outdoor aerobic exercise more than three times a week, and ozone is a frequent problem in your city, cut back during the hottest months of the year and work out in an air-conditioned, well-filtered room.

- **Keep carbon monoxide at a distance.** High levels of carbon monoxide accumulate at their sources — highways and busy city streets. Avoid exercise in these heavily trafficked zones. Choose locales like parks (when they're closed to traffic), or waterways (that aren't paralleled by roads). Carbon-monoxide levels can run high in both warm and cold weather. Western states experience peaks during winter months.

- **Reduce the pollution you generate.** By the end of this year we should have a revamped Clean Air Act aimed at curtailing urban smog, toxic pollution, and acid rain. But we can all make a difference in the battle against unhealthy air by using public transportation whenever possible, avoiding the use of solvent-based paints, and reducing our use of household chemical products.

There's no question that more research is needed before we'll know the long-term effects of healthy exercise in unhealthy air. Scientists generally agree that they need to thoroughly investigate the toxicological effects of ozone, acid aerosols, and combined pollutants. Based on the data that's already in, some scientists are calling for a tightened am-bient ozone standard. There's no telling how long a reevaluation of that standard could take.

In the meantime, take precautions to offset the potentially harmful impact of pollutants. For the past nine years, Kesa Tsuda has taken her evening runs along a suburban Los Angeles beach, where sea breezes keep smog at bay. During a recent physical, she learned that her lungs are working at more than 140 percent of capacity. "You haven't lived in southern California your whole life, have you?" her doctor assumed. He was surprised to find out that, indeed, she had.

NATURAL VS. SYNTHETIC

PERSONAL HYGIENE PRODUCTS

Who's Minding the Beauty Business?

by Francesca Lyman

PHOTOS: DON BETTS

In the back-to-nature 1970s, *every* cosmetics bottle and jar boasted some sort of organic ingredient — be it marigold or henna, aloe or avocado — even though a quick look at the label of most brands would tell you the product was hardly "all natural."

Fashions went the other way in the '80s, when companies from Clinique to Revlon began cloaking their products in the mantle of hard, unromantic science. They put their saleswomen in starched, white lab coats, gave products pseudoscientific names and wrote ad copy about "pH balance," "cell renewal," "electro-bond proteins," and other wonders that left chemists and dermatologists scratching their heads.

Now the "natural" trend is making a comeback. The growth of small alternative-cosmetics companies like The Body Shop, which emphasizes natural ingredients and minimal packaging and does no commercial advertising, is a sign of the times. "People are turning [products] over to see how the labels read," says Michael Waldock, president of The Body Shop, U.S.A. "They're worried about the side effects. They ask themselves, 'why should I have this stuff in my daily life?'"

Yet the growth of the health-conscious market has done nothing to help define what's meant by "natural cosmetics," a loose term generally taken to mean products made primarily of plant-derived ingredients (aloe, herbal extracts, etc.). Alternative-cosmetics manufacturers, distinguished in the past decade for not using chemicals that require animal testing (see page 59), make the additional claim that their products are *healthier* for your skin, hair, and body. Some imply that their products are less harmful to the environment as well.

These companies have made marketing inroads via drugstores, hair salons, and health-food stores. Whether they're family-run start-ups brewing herbal potions on woodstoves, or larger companies with a full line of cosmetics, their numbers are growing, with more products finding their way into drugstore chains and nutrition outlets. Tom's of Maine, for example, known as the first company to take artificial sweeteners out of toothpaste, expects this year to chalk up more than $10.5 million in retail sales. (Still, Tom's has a long way to go before it matches industry giants. Procter & Gamble Co., maker of Crest and Gleem, sells toothpaste to the tune of $500 million annually.)

• IS NATURAL BETTER?

With "natural" reappearing as a marketing buzzword in our neo-environmental decade, consumers need to ask: Do natural ingredients make a cosmetic perform more healthfully and effectively — or just *sell* more effectively? Be aware that many conventional cosmetics are marketing the magic of some natural ingredient, such as marigold or lavender, although that ingredient appears in a negligible amount. Even cosmetics containing a larger percentage of so-called natural ingredients may contain synthetic preservatives and colors.

Certainly, no definitions or standards have been established for the term "natural," either through the natural-foods industry or under the Food and Drug Administration. The FDA doesn't police natural cosmetics any more than it regulates any other cosmetics (more on that later).

Even talking directly to the natural-cosmetics industry yields little hard information. Are the products really healthier for you? The companies say "natural is better." Ask why, and you get some variation of "because *natural is better*." In his book *Natural Organic Hair and Skin Care*, cosmetics maker Aubrey Hampton expounds: "The more natural the product the more advantages it has for your skin, and by reducing or eliminating the use of synthetic chemicals, petrochemicals, and hydrocarbons on your skin (and in your hair), you will be in harmony with nature."

Natural-cosmetics makers aren't the only people to believe that natural is better "just because." Unfortunately for the credibility of their claims, however, none of them can cite studies or even surveys that show natural cosmetics to be any healthier for your skin than synthetic cosmetics, or that a natural-cosmetics regimen will improve your skin.

Dermatologists and the medical establishment tend to ignore natural cosmetics, if they know much about them at all. "The health [benefit] of natural cosmetics is primarily psychological," concludes New York dermatologist Diana Bihova. She acknowledges that "theoretically, the more chemicals [in cosmetics], the more reactions people could have." But she cautions that people can be just as allergic to natural substances — fruit and vegetable derivatives found in natural cosmetics — as to synthetic types.

Of course, manufacturers who base their products on organic, non-synthetic, plant-based formulations often go out of their way to eliminate common irritants and allergens, many of which are ubiquitous in conventional cosmetics. Still, there is lively debate among scientists and dermatologists as to whether "organic" cosmetics are any

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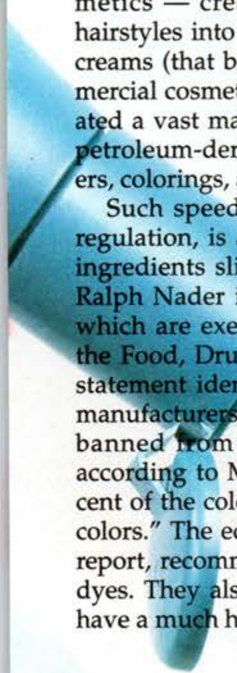
Francesca Lyman writes frequently about the environment; her book The Greenhouse Trap *was published by Beacon Press this spring.*

more *effective*. Doctors point out that some claims are clearly overstated, as the ingredients, pure or not, don't penetrate the skin enough to have much effect.

• THE SYNTHETICS EXPLOSION

We're unlikely to find any consensus on whether natural is better — and anyway, that segment of the market remains small. What about the health effects of the bigger market: conventional, brand-name hygiene products?

At no time in the history of the world have people consumed such a volume and variety of cosmetics. (Sales of cosmetics and toiletries have doubled since 1980, from $9 billion to $18 billion per year, according to Kline and Company, Inc.) Before the Second World War, retail sales of personal-care products were only about .2 percent (or one five-hundredth) of what people today buy. Most of this growth can be attributed to fantastic developments in synthetic chemistry.



Since the postwar years, chemists have found ways to manufacture ingredients that once were taken from natural sources (replacing the potash-based soaps used to wash hair with free-flowing shampoos containing foaming agents, for example). At the same time, cosmetics chemists vastly extended the range of effects made possible by cosmetics — creating polymers for hairsprays (that sent hairstyles into orbit in the 1950s) and aerosols for shaving creams (that banished shaving brushes). In turn, the commercial cosmetics industry has in the past half century created a vast market for chemicals — emollients made from petroleum-derived compounds, foaming agents, thickeners, colorings, and whiteners.

Such speedy proliferation, accompanied by a lack of regulation, is at least cause for a second look. And some ingredients slip through regulatory cracks. One cited by Ralph Nader is the family of hair dyes made of coal tar, which are exempted from the adulteration provisions of the Food, Drug, and Cosmetic Act if theybear a warning statement identifying potenttial health threats. "Hair-dye manufacturers may continue to use coal-tar color additives banned from use in food, drugs, or other cosmetics," according to Mr. Nader's *Buyer's Market*. "About 99 percent of the colors used in hair dyes are not FDA-approved colors." The editors note that Consumers Union, in a 1978 report, recommended that pregnant women avoid all hair dyes. They also cite evidence showing that salon workers have a much higher incidence of certain cancers.

• WHAT'S THE HARM?

An entire industry has grown up around worry about synthetics in cosmetics — but has anyone really been hurt by them? Dermatologists say it's common for people to use the wrong cosmetic for their skin. Some young women, lured by advertising, buy lavish treatments that are too rich for their skin. Cosmetics can aggravate acne, especially when the wrong product is used. Many companies test their products for just this reason, labeling them "non-comedogenic" if results show the product doesn't block pores.

However, the common problem with cosmetics, according to the American Academy of Dermatology, is allergic reactions. An FDA study on reactions to cosmetics, conducted between 1977 and 1983, reports skin reactions ranging from three percent for sunscreens and 11 percent for makeup, up to 28 percent for lotions, creams, and skin-care products. These are almost never life-threatening reactions. The severest reactions to beauty products, says Ellen Gendler, a New York University doctor who is writing a book about cosmetics, are red rashes, swelling, stinging, and burning. "Fortunately, patch testing is a very simple procedure a dermatologist can carry out to help patients identify what they're allergic to," she says.

It has been easier to avoid allergens since 1977, when federal law required listing of ingredients in descending order of content on the labels of retail cosmetics. Before that time, victims of allergic reactions had to pry information from the companies, who often weren't happy about divulging product secrets.

Using a plant-based cosmetic containing organic ingredients won't necessarily prevent allergies, as people can be highly allergic to natural substances. "I've had patients coming in with severe reactions to Vitamin E [applied near the eye]," says New York dermatologist Alexander Fisher. Tocopherol, the active chemical in Vitamin E, can be "a terrific allergen," he adds.

Furthermore, truly all-natural formulations can go rancid or get moldy — perhaps worse for some allergic people than the effects of preservatives. Tom Conry, author of *The Consumer's Guide to Cosmetics*, considers natural formulations to be a double-edged sword. "[Claims made have] a terrific amount of truth, but the flip side is that there's a chance for bacteria, bugs, and allergens [to proliferate]. The consumer should not necessarily be less cautious [about natural products]."

For a time, cosmetics companies answered the allergy problem with "hypo-allergenic" lines (meaning "less" allergenic, according to the dictionary). Dermatologist Diana Bihova asserts that "most of the big reputable companies have eliminated the allergens."

Causes for Concern

According to the American Academy of Dermatology, fragrances cause more cases of allergic contact dermatitis than any other type of cosmetic ingredient. The FDA estimates that fragrances are responsible for 30 percent of all allergic problems. "Fragrance-free" products aren't an improvement over conventional cosmetics, according to a report in *FDA Consumer*, because cosmetics almost always contain some fragrances used to mask otherwise unpleasant chemical odors.

Also worrisome is the possibility that there is a growing hypersensitivity to chemicals among otherwise healthy people. Recent studies in the U.S. and Canada suggest an increase in the number of patients suffering from chemical sensitivity, which brings with it a wide assortment of symptoms ranging from headaches and respiratory problems to mental disorientation. And a 1989 report for the New Jersey Department of Health concluded that chemical sensitivity "exists as a serious health and environmental problem."

Chemistry breakthroughs such as the controversial antiwrinkle cream Retin-A begin to blur the line between cosmetics and pharmaceuticals. Scientists, skin experts, and manufacturers agree that these "threshold" formulations may have true therapeutic benefits. In other words, they're

Animal testing nears extinction

CRUELTY-FREE COSMETICS

If the thought of cosmetics conjures up visions of blinded bunnies, wipe the tears from your eyes. Cosmetics makers are finding other ways to safety-test their products.

The federal Food and Drug Administration doesn't require manufacturers of cosmetics (that's everything from hair spray and lipstick to toothpaste and shampoo) to test their products for safety. But, because many cosmetics include solvents, colors, fragrances, and preservatives that are toxic, most companies do test their products for acute toxicity and for skin and eye irritation. For decades, those tests have used live animals — rats, mice, guinea pigs and rabbits. A lot of people think that's a ratty idea.

Three common and controversial tests are the Draize eye-irritancy test, the LD50, and the skin-irritancy test. In the Draize, a product that could get into human eyes, such as hairspray or mascara, is applied in one eye in each of three unanesthetized rabbits, who are then monitored for irritation or blindness. In the LD50 toxicity test (the standard in all chemical testing), three to 60 mice or rats are force-fed an ingredient suspected to be toxic until 50 percent of them die. Finished cosmetic products may be fed in a single, standardized dose to six to ten animals in order to assess toxicity. Researchers extrapolate dosages to indicate how much of the product a child, for example, could eat without suffering dire consequences. In the skin-irritancy test, raw materials and products are applied to the shaved (and often abraded) skin of a rabbit or guinea pig. The skin is monitored for signs of irritation.

Animal-rights activists estimate that 14 million animals are used annually in the U.S. to test the toxicity and irritancy of cosmetics and household products. Many cosmetics manufacturers believe that testing their products on animals is safer and more effective than using *in vitro* (test tube) tests to uncover potential dangers. Animal tests are especially good at showing whether exposure to a chemical will affect organs throughout the body, while *in vitro* tests predict results only on isolated body parts.

Suffering and deaths aside (for the moment), animal testing *has* eliminated some dangerous chemicals from cosmetics use. Hexachlorophene and mercury compounds, both neurotoxins, as well as animal carcinogens vinyl chloride, methylene chloride, and chloroform, owe their banned-from-cosmetics status to animal testing.

The animal-rights movement, in the meantime, has growing support. Activists claim not only that animal testing is cruel and inhumane, but also that alternative tests exist. Growing awareness and customer pressure has led some manufacturers to do away with animal sacrifice: About 250 companies in the country make and sell cosmetics without testing the ingredients on animals, according to the People for the Ethical Treatment of Animals. Many rely on ingredients that humans have used safely for centuries, or that have already passed in tests on animals. Paul Penders, who began manufacturing his plant-based line in Holland, tested his makeup, gels, body lotion, and bath oil on a convent of nuns who sympathized with his battle against Dutch animal-testing requirements.

"None of the nuns died," reports Mr. Penders, who has moved his company to California. "For the first time in their lives, the nuns wore lipstick."

Manufactures can turn to an increasing number of *in vitro* tests. Avon, for instance, has laid off its rabbits and hired Eytex, test tubes full of vegetable protein that mimic the human cornea's reaction to irritants. At about $250 per test, Eytex may cost hundreds of dollars less than the Draize test. Avon and others can also access IRIS, the EPA's computerized database of toxicological information. Human volunteers are used for skin-irritancy testing.

The animal-rights movement and cruelty-free cosmetics makers have pushed even giants of the cosmetics industry to liberate their rabbits and rodents. Since March 1989, Avon, Revlon, and Estee Lauder have announced bans on animal testing. Noxell Corp., makers of the Cover Girl line, is one of several companies opting for an animal-testing moratorium; they reserve the right to restock their animal labs if *in vitro* methods fall short of expectations.

Many other companies have so far resisted. Johnson & Johnson, Chesebrough-Pond's, Clairol, and about 65 other cosmetics companies are still being hounded by animal-rights groups because of their animal-testing policies.

While even *in vitro* researchers agree that test tubes can't replace all animal testing (i.e., if a new chemical has uses outside the cosmetics industry, the EPA may step in and *require* animal testing), since 1988, dozens of companies have escaped the animal-testing trap by using ingredients that have already passed animal testing — or the test of time.

For a list of companies that don't test on animals, write to: People for the Ethical Treatment of Animals, P.O. Box 42516, Washington, DC 20015, (301) 770-7444. —*Hannah Holmes*

not just makeup. NYU's Dr. Ellen Gendler is one dermatologist who believes that a new category in between drugs and cosmetics is likely to emerge.

With increased benefit, of course, comes a higher price for misuse. We may want to take a second look at the long-standing non-regulation of the cosmetics industry.

• NO TESTING. NO REGISTRATION.

Contrary to what you might think, cosmetics are not required to be tested for safety, nor are companies required even to register new products or manufacturing plants with the government. (Registration enables the federal Food and Drug Administration to determine where it should conduct inspections — the primary enforcement tool for overseeing the $18 billion-a-year cosmetics industry.) The General Accounting Office, the research arm of Congress, recently reported that fewer than 40 percent of the 2,000 to 2,500 manufacturers and packers of cosmetics are registered.

The GAO also reported that only about three percent of an estimated 4,000 to 5,000 cosmetics distributors have filed reports from consumers claiming to be injured by their products. Under current law (which dates to 1938), the FDA does not have the authority to require the cosmetics industry to do safety testing, even though many manufacturers lack adequate data on safety tests and have generally refused to disclose the results of those tests, the study said.

Just how does the government monitor cosmetics safety? The cosmetics section of the Food, Drug, and Cosmetics Act is known within the FDA as an "after-the-fact law," meaning that a cosmetic chemical cannot be banned, nor a product seized, until the FDA receives enough consumer complaints to warrant toxicological testing. In effect, the agency cannot conduct safety tests until a consumer claims an "adverse reaction" — otherwise known as an injury — from a cosmetic product.

According to Heinz J. Eiermann, director of the FDA's division of colors and cosmetics, the agency takes action against "about two dozen" products each year. The latest chemical banned from cosmetics was methylene chloride, a hairspray propellant (and the active ingredient in liquid paint strippers) that causes cancer in lab animals.

"There are only two actions the FDA can take to protect consumers," asserts Rep. Ron Wyden (D-Ore.), "— seize a contaminated batch of product, and ask manufacturers to change their advertising claims." Rep. Wyden intends to introduce legislation giving the FDA greater authority to regulate the industry. He chairs Congress's small-business subcommittee on regulation, which held hearings on the issue in 1989. At these hearings, it was reported that cosmetics used by cosmetologists have caused problems including asthma, upper-respiratory infections, skin diseases, reproductive complications, and neurological damage.

The government does require a manufacturer to list the ingredients on the labels of all cosmetics, but cosmetics not distributed for retail sale and used primarily by professional cosmetologists are exempt from this FDA requirement. That brings up the group that may be most at risk — beauticians who have regular exposure to the chemicals, sometimes in "professional-strength" formulations. With this group, the question of whether chronic exposure to cosmetics presents health hazards in the long term is critical. Rep. Wyden's subcommittee took up that question when it held hearings on cosmetics regulation. Among other witnesses, the subcommittee heard testimony from beauticians whose exposure to beauty-parlor chemicals, from permanents to sculptured nails, had given them chronic asthma and nervous-system disorders.

Don't Panic

At one subcommittee meeting, Mr. Wyden made public a list of 884 chemicals available for use in the manufacture of cosmetics that have caused harmful side effects when tested on animals. The cosmetics industry believes that there are no major safety concerns with any of the ingredients on the list. Nevertheless, hair dyes made with coal-tar dyes are known to cause mutations and cancer in laboratory animals. And such seemingly innocuous products as shampoos and moisturizers contain dyes, preservatives, and other chemicals whose long-term effects (even in relatively minute amounts) aren't known.

Mr. Wyden notes that the Food, Drug, and Cosmetics Act has 22 pages of standards for the food industry and 90 pages of standards for drugs, but only one page for cosmetics. Despite cosmetics labeling, "the government has no idea what's in many of these ingredients," says the representative.

"Consumers shouldn't panic, but they should be concerned," he continues. "We [have to] wait for people to fall over clutching their sides before we can take action. That's particularly worrisome when we don't even know the long-term health effects of many of these ingredients."

Mr. Wyden's proposed legislation would require cosmetics companies to register their legal addresses, keep adequate safety data and regularly disclose it to the FDA, and file injury reports. "It's not exactly a radical notion to ask a reputable company to file its address with the government," he adds. But the powerful cosmetics-manufacturers lobby is resisting.

• THE INDUSTRY SPEAKS

The Cosmetics, Toiletry, and Fragrance Association (CTFA), a trade group representing companies that manufacture and distribute personal-care products, says that the cosmetics industry has an unparalleled safety record, and that the government has sufficient authority to regulate manufacturers. The group believes that Rep. Wyden's proposals would divert FDA resources from such problems as AIDS, new-drug approval, and food safety. "We have *real* health issues to worry about," wrote the group's president, Ed Kavanaugh, in the April 12 issue of *USA Today*. "Let's not fritter away our time and tax dollars to solve a non-existent problem."

The industry says that even though only three percent of cosmetics distributors filed injury reports with the government, these companies make about 60 percent of the cosmetics marketed. CTFA questions the need for increased participation, since they believe the companies filing injury reports are representative of the industry.

"We wouldn't get 100-percent compliance even if the voluntary program were mandatory," says Elaine Kite, a spokeswoman for the group.

Ms. Kite contends that products have been recalled only because of misapplication, not because of any serious safety problem. When asked about FDA action against specific chemicals used in cosmetics, she replied, "I can't get into product ingredients." When asked about the 884 toxic chemicals available for use in cosmetics, she said the industry does have a review program, an independent panel of experts which has evaluated the list of chemicals and found "no safety problems." In the absence of government regulation, of course, the panel study was funded by the cosmetics companies.

There is one real constraint on companies to market safe products: an economic one. Fear of liability is a powerful incentive. Beyond that, consumer savvy — the same factor that created the market for alternative products — judges the competitors. In the end, knowing what we're buying may protect us as well as any stab at government regulation.

BEGIN AT HOME

ELIMINATE ORGANIC ODORS
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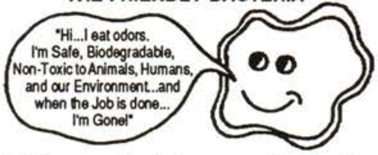
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Q: *I just graduated from college and have been thinking about a career in the environmental field. Trouble is, I don't have much of a science background. How can I find out more about the sorts of jobs that would be available to me?*

Jonathan Lowrey
Baltimore, Md.

A: Chemists and physicists will be in demand — but physical science isn't the only useful background to have. Opportunities exist in the public and private sectors for administrators, managers, educators, and researchers dedicated to monitoring and improving the environment.

A leading source for contacts is the Boston-based Center for Environmental Intern Programs (CEIP), a nonprofit job-counseling and placement service that periodically sponsors environmental-career seminars. It also annually places 300 college students and recent graduates in short-term, paid, entry-level positions with corporations, consultants, government agencies, and nonprofit organizations. CEIP reports that 20 percent of their interns receive permanent offers from employers; 90 percent of the others find environmental jobs after they've completed their internships.

CEIP's National Director Kevin Doyle says that the environmental field needs people with strong communication, research, and negotiation skills. (A technical understanding can be gained through graduate work or professional seminars, Mr. Doyle points out.) CEIP interns help develop community recycling programs, conduct market research for recycling companies, and educate local groups on hazardous- and solid-waste issues. Prospective interns *with* science degrees are typically offered technical research work at environmental planning agencies, chemical-waste management firms, or natural resource-protection organizations. Write to the CEIP Fund, Inc., 68 Harrison Ave., Boston, MA 02111, or call (617) 426-4375.

Another good source for environmental career opportunities is CEIP's *The Complete Guide to Environmental Careers*. Profiles of professionals in the areas of environmental protection, natural-resource management, and environmental education and communication are provided. The softcover guide is available for $16.95 from Island Press, P.O. Box 7, Covelo, CA 95428.

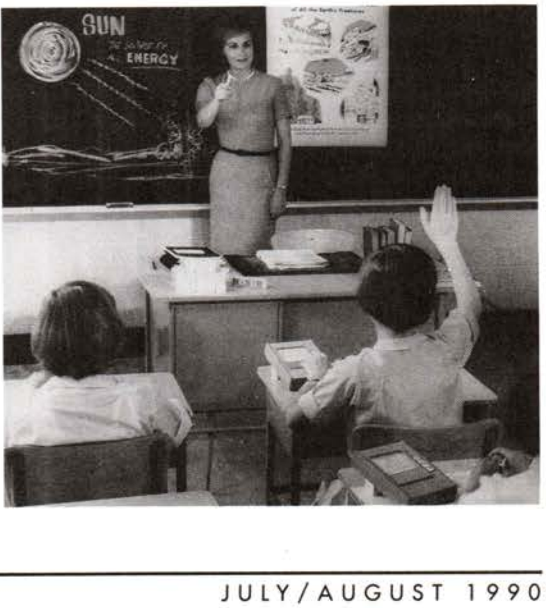
Two newsletters list environmental jobs at every level. *Environmental Job Opportunities* is published 10 times yearly (subscription $10) by the Institute for Environmental Studies, University of Wisconsin-Madison, 550 North Park St., 15 Science Hall, Madison, WI 53706. *Job Scan* is published monthly by the Student Conservation Association, P.O. Box 550, Charlestown, NH 03603; $22 for six months or $39 for one year.

Q: *Are all types of forests equally valuable in the struggle to slow global warming? Does, for example, one acre of evergreen forest absorb as much carbon dioxide as an acre of tropical rain forest?*

Katrin Tobin
East Palo Alto, Calif.

A: Living trees soak up carbon dioxide and break it down, storing the carbon in wood and releasing the oxygen back into the atmosphere. Carbon dioxide, present naturally in the atmosphere in very small amounts, helps maintain a temperate climate by trapping heat radiated from the Earth's surface. *Too much* carbon dioxide in the atmosphere, however, traps too much heat, a process that many scientists believe has contributed to elevations in global temperature over the past century. Scientists are increasingly concerned that further global warming could lead to dramatic and potentially destructive climate changes.

Climate determines a tree's rate of carbon-dioxide absorption. Most growing trees (no matter what the species) absorb carbon dioxide at about the same rate, as long as they're getting enough water and sunlight. During cold-weather months or periods of drought, trees become dormant — growth stops and little or no carbon dioxide is absorbed. Because tropical rain forests are not subjected to temperature extremes, they grow and absorb carbon dioxide throughout the year. Consequently, they take in more



"Today's question: Do all forests combat global warming?"

PHOTOS: INDEX STOCK/BLACK BOX

carbon dioxide than do evergreens such as the cedar and fir, which grow in northern climates. (Trees that grow in tropical rain forests are broad-leaf evergreens. A temperate climate, such as the one found in most of the United States, usually breeds needle-leaved conifers.)

According to Robert Miller, professor of forestry at the University of Wisconsin–Stevens Point, carbon dioxide absorption slows as a forest matures. That's because while immature trees are still growing and absorbing carbon dioxide, older trees are decaying — absorbing less and expending more carbon dioxide. Older trees increasingly offset the gains made by younger trees. However, in a mature forest a lot of carbon is tied up in the ecosystem and not in the atmosphere, a condition that will persist until the forest is disturbed by nature or people (through fire or clear-cutting, for example).

Worldwide deforestation (removal without replacement) contributes about 20 percent of the annual carbon-dioxide emission. Stopping deforestation will keep carbon in trees and out of the atmosphere. "Forests are a renewable resource, and we can manage many of them to meet human needs and to help remove some of the excess carbon dioxide in the atmosphere," says Professor Miller. "Trees can help, but in the long run the solution to excess carbon dioxide in the atmosphere is to stop burning fossil fuels."

GOT A QUESTION?

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—Theodore Roosevelt

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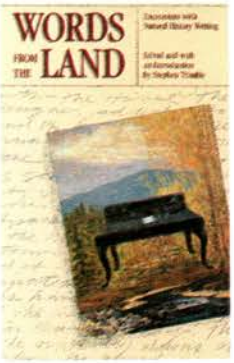
Words from the Land: Encounters with Natural History Writing

Edited by Stephen Trimble. 303 pages. Gibbs Smith, P.O. Box 667, Layton, UT 84041. Softcover, $11.95 ppd.


WORDS FROM THE LAND
Encounters with Natural History Writing
Edited and with an Introduction by Stephen Trimble

This collection of essays opens on a beach in the Galapagos Islands with author Annie Dillard, a tortoise, and some single-celled algae. Ms. Dillard slips into a discussion of Darwin and Social Darwinism, emphasizing the ability of animals to communicate with each other, despite the great gulf of species differentiation. She illustrates with vignettes: A sea lion falls asleep with his head on her arm, a flock of finches comes to a human call. Ms. Dillard, new on the scene and heartily welcomed by the other creatures, compares herself to Adam. "Go," she urges, "and be greeted by the sea lions."

Other pieces are equally striking. Gary Nabhan presents a surprisingly compelling history of panicgrass, a crop once treasured by Cocopa Indians of the Colorado River region. The crop disappeared when the Colorado was diverted for irrigation at the turn of the century. When a 600-year-old cache of seed was discovered in a cave, it set off a quest for living plants. Mr. Nabhan found fresh seed in a remote Mexican community, and returned panicgrass to the U.S. and the Cocopa Indians.

Essays include Edward Abbey's intellectually boisterous account of a trip down the Green River with a copy of Thoreau's *Walden*; Gretel Ehrlich's exploration of the psychological effects of flood and drought on ranchers living below Wyoming's Big Horn Mountains; and David Quammen's "Chamber of Memory," a languid meditation on the relationship between the nautilus mollusk and the human. In all, there are 20 pieces by well-known nature writers. Together, they echo a benign bit of wisdom: Our quality of life, and even peace of mind, is tied to the quality of life of the other inhabitants of the planet, be they plant or animal.

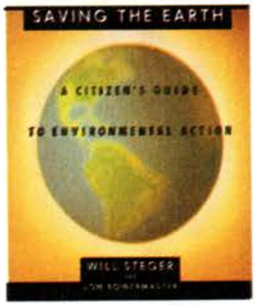
— Hannah Holmes

Saving the Earth: A Citizen's Guide to Environmental Action

by Will Steger and Jon Bowermaster. 306 pages. Alfred A. Knopf, New York, NY. Softcover, widely available for $19.95.

A "save the Earth" book that talks straight to the reader, this one demystifies environmental problems without scientific jargon.

Each chapter is illustrated with cartoon-style graphics demonstrating cause-and-effect relationships that degrade the environment. Graphics depict chemical reactions like those that turn your car exhaust into acid rain and the processes that bring the acid rain back into your life; or how a web of hazardous pollutants infiltrates the food chain. Extremely complex relationships become clear.



A sharp, fact-rich overview fills the initial pages of sections ranging from hazardous waste to water pollution to energy consumption — and the future. Charts and graphs clarify murky subjects. A chart analyzing 50 years of harvests from rain-forest land, for example, demonstrates that ranching and timber production are economically, as well as ecologically, shortsighted.

Each section ends with practical actions for the reader, along with a brisk list of public policy proposals, reading suggestions, and a directory of pertinent organizations.

— Hannah Holmes

Green Magazine For Our Environment

Northern & Shell, Hainault Road, Little Heath, Romford, Essex RM6 5NP, UK. Subscription: one year (10 issues) $78 (payment by American Express, VISA, or money order only).

It seems that **GARBAGE** has a distant cousin in this new, London-based environmental magazine. Although *Green* has a strong political bent, it also offers some practical information on environmentally sensible household management.

Regular departments include sardonic pieces aimed at the consumer. The "Green Gremlin Awards" spotlight products or concepts that are environmentally ill-conceived. (Editors take the makers of Theakston's Old Peculiar Ale to task for marketing over-packaged, plastic three-packs). "Basket Cases" is a graphically savvy two-page spread that juxtaposes environmentally questionable supermarket products with sounder alternatives. On a more serious note, "Food for Thought" explores the health and environmental effects of chemically growing and processing food. Absent, though, are useful tips for finding safe food in the marketplace.

Green features heart-tugging stories on endangered wildlife populations and indigenous peoples, and technical, science-based pieces on fuel-conserving wind generators and combined-heat-and-power facilities. International and local issues are covered.

Launched last September as an independent publication, *Green's* UK readership defies categorization. Housewives, students, and active Green Party members all seem to be picking it up. It should also win fans on this side of the Atlantic.

— Ginia Bellafante

Forests: A Fact-Filled Coloring Book

by Bettina Dudley, illustrated by Helen I. Driggs. 128 pages. Running Press, 125 South Twenty-second Street, Philadelphia, PA 19103. $9.45 ppd.

Here's a great way to bring the world's woodlands to children from ages eight to 12. *Forests* is not just a coloring book: Pages alternate between readable text that introduces forest science and detailed drawings that illustrate each lesson. For example, as children color in the bristlecone pine, they'll learn that it's the world's oldest living tree — over 4,500 years old.

Basic concepts of forest biology are introduced, such as the difference between angiosperms and gymnosperms, conifer trees and deciduous trees. Children will learn how chlorophyll is used in photosynthesis, and how to tell a tree's age. Another section explores many of the Earth's forests, from the redwoods of California to the pine barrens of New Jersey; from Brazil's rain forest to China's bamboo forest.

The last section spotlights acid rain, clear-cutting, and other threats to woodlands. *Forests* doesn't burden kids with problems, but prompts them to think about the future. "More and more people want to save the rain forests," Bettina Dudley writes. "They hope that their children's children will share their world with the same plants and animals in this book. Don't you hope that a coloring book 200 years from now could still show a toucan and a sleepy sloth?"

— *Bruno R. Tedeschi*

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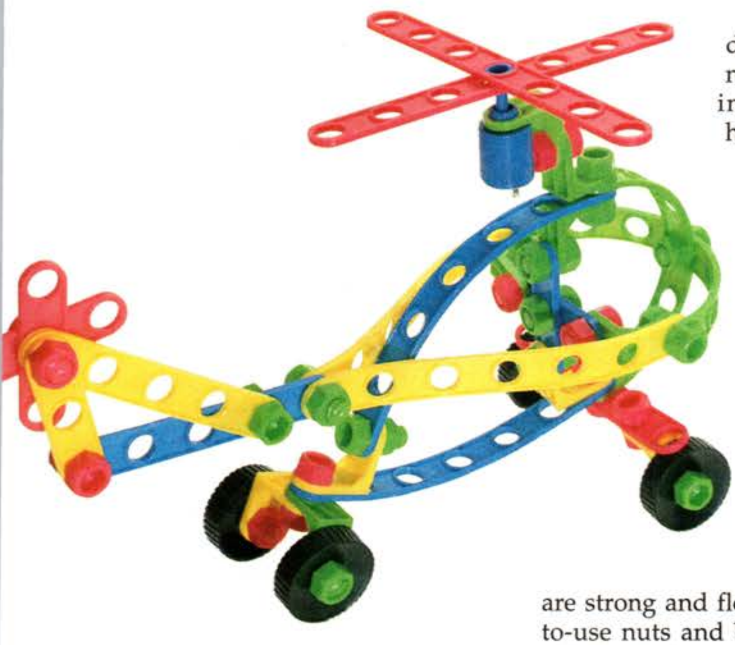

Solar Construction Toy

Judging from the way our staff took to the solar building kit when it arrived, this toy should be a hit! It inspires children to invent weird, new machines (the kit includes plans for a helicopter, airplane, water mill, and windmill). Once the creation is completed, the pieces you attached to the solar-powered motor will spin for as long as the sun shines. The little solar panel powers the motor even on diffused sunlight.

The bright, plastic components are strong and flexible, with big, easy-to-use nuts and bolts. The toy is suitable for kids age five and up, and up. The designs are appealing, and the power source is fantastic: We buy three billion household batteries each year in the U.S.; the poisonous heavy metals they contain haunt us long after their useful life is over. Too many battery-powered toys perpetuate the problem.

But the 4-in-1 Solar Construction Kit avoids battery dependence as it teaches children about a renewable energy source. It retails for $15 – 20.

We know of two mail-order houses that carry the toy. Jade Mountain specializes in alternative-energy products for all ages: Dept. GM, P.O. Box 4616, Boulder, CO 80306, (800) 442-1972; in Colorado, (303) 449-6601. Seventh Generation carries an array of environmentally-safer products: Dept. GM, Colchester, VT 05446-1672, (800) 456-1177.

Solar-powered toys avoid batteries.

Safer Insect Repellent

Those of us who spend time in the woods can appreciate a good can of N,N-Diethylmeta-m-Toluamide – call it DEET; not to mention a splash of 2,3,4,5 Bis(2-butylene) tetrahydro-2-furaldehyde (R-11), a.k.a. bug dope. DEET is the main ingredient in most insect repellents like OFF!, Bens, and Cutter; R-11 is often added to fend off black flies and no-see-ums.

As is sometimes the case with miracle cures, the repellents have a dark side. The makers of Cutter, OFF!, and many other brands announced recalls of their products in April when R-11 was found to cause tumors in lab animals. DEET is readily absorbed by human bodies, sometimes causing reactions ranging from rashes to convulsions, and very rarely, even death. Children may be especially vulnerable to DEET.

Swaddling yourself in mosquito netting is probably the healthiest way to get through the insect season. But there are alternatives if you want to swat the R-11/DEET without looking like a geek. The plant-based formulas we found rely on oil of citronella, a grass with a powerful, lemony scent that bugs hate. (Put on too much and your friends will hate you, too.) While gardeners may rub fresh leaves right onto their skin to keep the bugs away, these proprietary recipes mix the citronella oil with skin-soothing calendula oil or aloe extracts. Citronella may be botanical, but it's still dangerous if it's ingested — keep it out of the reach of children.

Green Ban uses calendula. It comes in 5-ounce bottles of regular ($11.90) or double-strength ($13.90) formulations; add $2 for shipping and handling. Order from Co-op America Order Service, Dept. GM, 49 The Meadows Park, Colchester, VT 05446; (802) 655-2975.

Natrapel uses aloe. It costs $8.95 plus $3.50 shipping and handling for two 4-ounce bottles of either pump-spray or cream. Order from Gardener's Supply, Dept. GM, 128 Intervale Rd., Burlington, VT 05401; (802) 863-1700.

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Shoe polish safe for cocktail parties.

Crack a container of shoe polish and take a whiff. That old-fashioned pungency, alas, may be bad for you. Shoe polishes contain ammonia, alcohol, turpentine, nitrobenzene, or even trichloroethane and methylene chloride – suspected human carcinogens. (One healthy-home booklet even warns against wearing your newly polished wingtips to a cocktail party, because alcohol will boost the toxic effect of nitrobenzene if you're inhaling fumes from not-quite-dry shoes!) Because the ingredients in shoe polish are rarely listed on the label, it's tough to know what you're buying.

Various combinations of beeswax, lemon juice, oils, and elbow grease can shine up dull shoes. But if this sounds like too much fancy footwork, try a recipe that someone else has already concocted. Livos' leather polish is made from beeswax, carnuba wax, and shellac wax, with rosemary and linseed oils, citrus thinner, and earth pigments. A 3.4-ounce glass bottle of brown, black, or clear polish is $5.95; a set of 1.7-ounce jars of each color is $10.50. Shipping is $4.

Livos PlantChemistry, Dept. GM, 1365 Rufina Circle, Santa Fe, NM 87501; (505) 438-3448.

Recycled Plastic Stumps Rubbermaid

Rubbermaid Inc. just announced that it's dropping its proposed line of recycling bins made of recycled plastic (see *Keepers*, page 62, May/June), saying that it can't find a way to recycle 100 percent mixed plastics at a competitive price. Rubbermaid's cancellation of the Stack 'n Cycle recycling bin, which it had advertised nationally and planned to distribute directly to municipalities as well as through 50,000 retail outlets, underlines the difficulties inherent in manufacturing products from mixed-plastic refuse.

Recycling one type of plastic is relatively easy, says Don Awbrey, vice president of operations support at Rubbermaid, because the manufacturer knows what heat and chemical processes the plastic resin has undergone. But with the mixed bag of plastic that often confronts the producer of recycled-plastic products, the manufacturing process has to be flexible enough to accommodate combinations of plastic which change over time. Contaminants like labels, metals, or uncommon resins can also weaken the new plastic.

Washing reclaimed-plastic chips, or melting them and putting them through a filter, can be expensive, says Dr. Deran Hanesian, a researcher at the Rutgers Center for Plastics Recycling Research. Rubbermaid "may not be able to do it economically," he says. "Anything is possible technically."

Shopper's Hotline

Chagrined by the gremlins of green consumerism? Confounded by conflicting claims? Who ya gonna call? The Pennsylvania Resources Council has established a national toll-free hotline for confused shoppers. Packaging is their specialty – how to spot recycled, recyclable, and just plain excessive packaging. Call (800) 468-6772 (GO TO PRC) to cut through the hype.

Rubber-Bladdered Rust Buster

Spray lubricants like WD-40 are great for rusted fishing reels, door hinges, and engine bolts. They squirt into places your fingers can't reach.

But the propellants that make the aerosols work pose slippery environmental problems. Hydrocarbon propellants, which have replaced chlorofluorocarbons and may account for 25 percent of some products, contribute to smog; so do the petroleum-based solvents used to carry the lubricants. Pump sprays don't require propellants but, like aerosols, they don't work too well when you hold them at an angle or upside-down.

E-Z-1 lubricant uses a new technology in spray cans. Inside the high-density polyethylene container is a rubber bladder that swells when it's pumped full of lubricant. When you press the button, a strong, fine spray of lubricant comes out. The bladder keeps the liquid under constant pressure, so it even works when it's upside-down. (The lubricant itself is a synthetic hydrocarbon that the maker claims is essentially non-toxic.)

A 7-ounce bottle seems expensive at $9.95 (plus shipping), but remember that you're getting 100-percent product, without the 75 percent propellants and solvents that cheaper cans may contain.

To order, contact E-Z-1 Corp., Dept. GM, 3500 North Harrison, Shawnee, OK 74801; (800) 255-6235.

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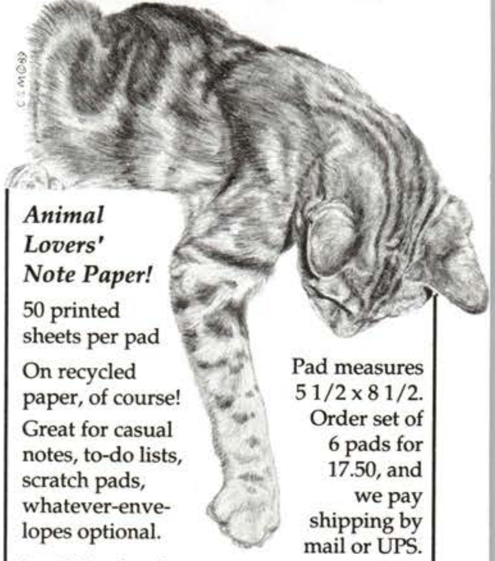

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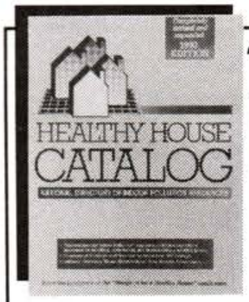

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- The average American spends over two full days per year opening unwanted mail and still opens only half of what is received!

What can you do about it?

Many environmental groups and publications urge Americans to write the Direct Mail Association and to return unwanted junk mail to senders with a letter asking them to remove their names from mailing lists. This solution would take the average American over four hours and cost $25 in postage just to cancel 100 pieces of junk mail. Most of us don't have the time or are unwilling to spend the money to limit our junk mail.

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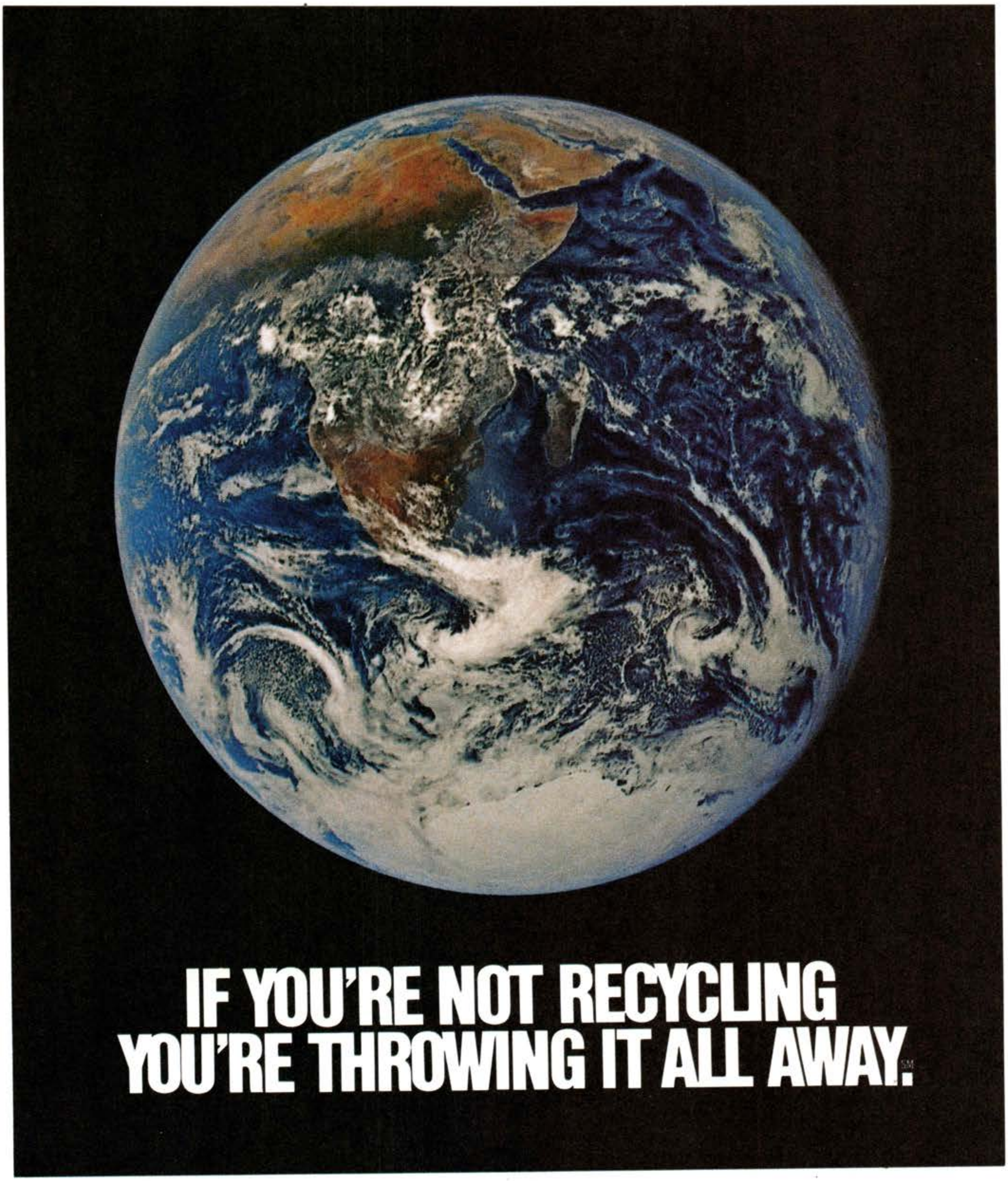

A little reminder from the Environmental Defense Fund that if you're not recycling, you're throwing away a lot more than just your trash.

You and your community can recycle. Please write the Environmental Defense Fund at: EDF-Recycling, 257 Park Avenue South, New York, NY 10010, for a free brochure that will tell you virtually everything you need to know about recycling.

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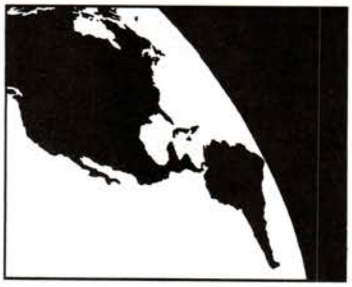
Magazine for a Small Planet



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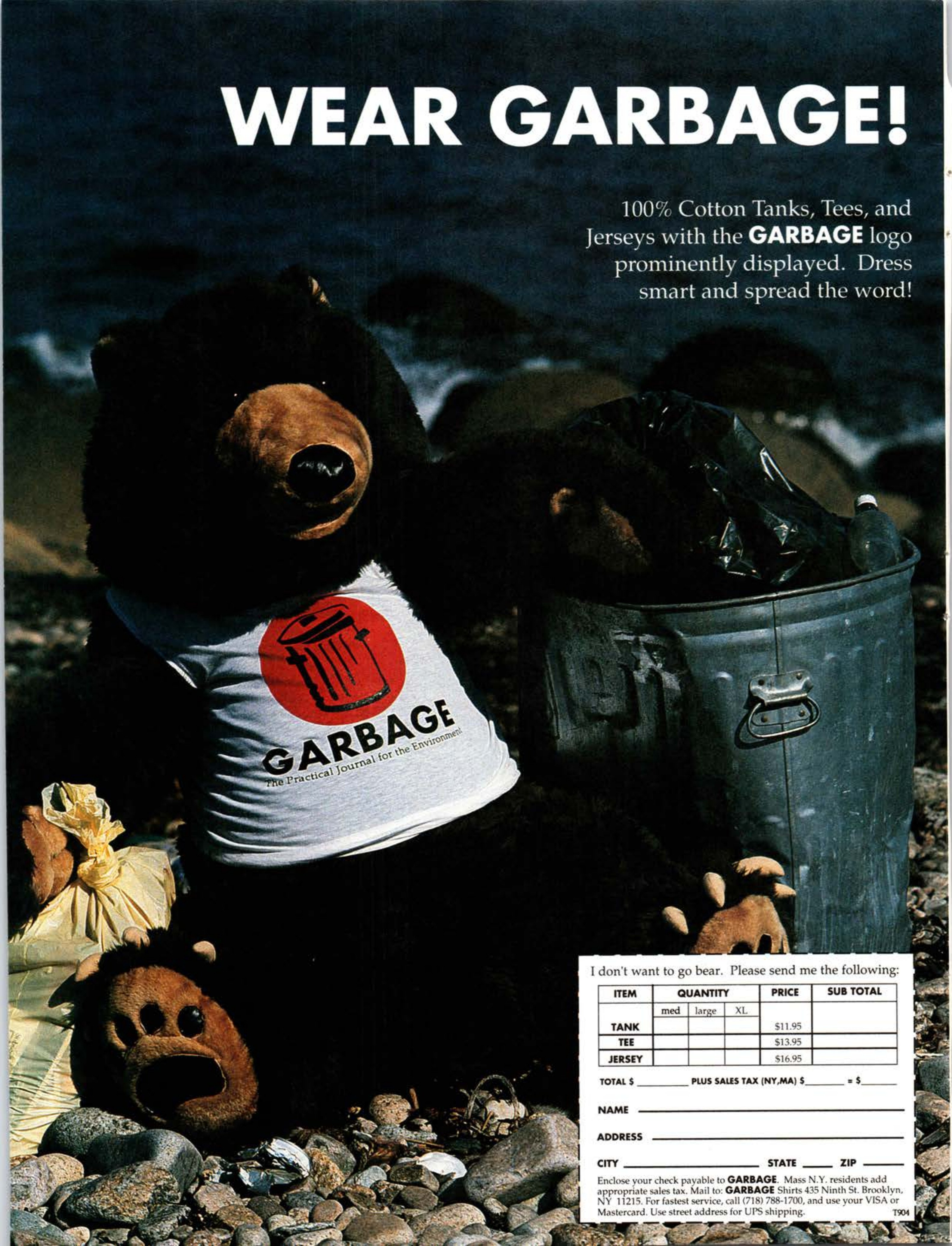

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103. Alternative To Paper & Plastic — Reusable grocery bag. All natural cotton canvas bag, screened with the live oak tree. 14"x10-1/4"x5". Save trees and keep earth day alive. Free literature. **RE-USA-BAG.**

104. Household Products — BIOFA Naturprodukte, manufacturers of natural paints, wood finishes, and household cleaning products. All materials are found in nature and can be returned safely to the environment. Free catalog. **Bau Inc.**

105. Environmental Cassetts — 45 pg. booklet summarizing the arguments against incineration and illustrating positive alternatives. Booklet and listing of VHS video tapes on solid waste crises, $3.25. **Video-Active Productions.**

106. Disposal Systems — The nation's leading recycling and trash-to-energy contractor. This firm develops, builds, and operates advanced and efficient integrated disposal systems. Free literature. **Wheelabrator Technologies, Inc.**

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From chemical-free food to cruelty-free cosmetics, a barrage of so-called "green products" grabs our attention in mail-order catalogs and now from supermarket shelves. Don't quite understand how "eco-cleaners" and "enviro-bags" protect the planet? Well, in some cases, their major contribution is simply to make *you* feel more responsible.

The problem is that the products are environmentally advantageous only in the narrowest sense. Maybe an "eco-smart" disposable (whatever that is) is less polluting — but its guilt-free label diverts us from issues like reducing waste. In each of the examples here, the product's sales pitch was written without the bigger picture in mind.

EarthRite Cleaning Products

"Americans will now be able to clean with a clean conscience," reads the press material for this green cleaning-products line from Magic American Corporation. Indeed, Material Safety Data Sheets, which list ingredients, do substantiate Magic American's claims of environmental safety. EarthRite cleaners contain no petroleum distillates, phosphates, bleaches, or synthetic dyes and fragrances, pollutants found in most other cleaning products.

But instead of combining or concentrating cleaning agents, Magic American produces EarthRite in six different bottles: All Purpose Cleaner, Tub & Tile Cleaner, All-Surface Floor Cleaner, and Wood and Paneling Cleaner. What does the "all-purpose" product do if we need to supplement it with five other cleaners, five other bottles? EarthRite pollutes less, but wastes more than single-bottle cleaners. (Also, the bottles are HDPE plastic, recyclable in very few areas.)

Recycled Paper Towels

Statler Tissue Inc. (Tree Free brand), Fort Howard Corporation (Green Forest brand), and others are producing paper towels containing recycled paper. They tell us that recycling saves trees, water, and energy, and creates 50 to 70 percent less air pollution than virgin-paper making. True enough. Conserving resources and reducing pollution in manufacture are laudable endeavors.

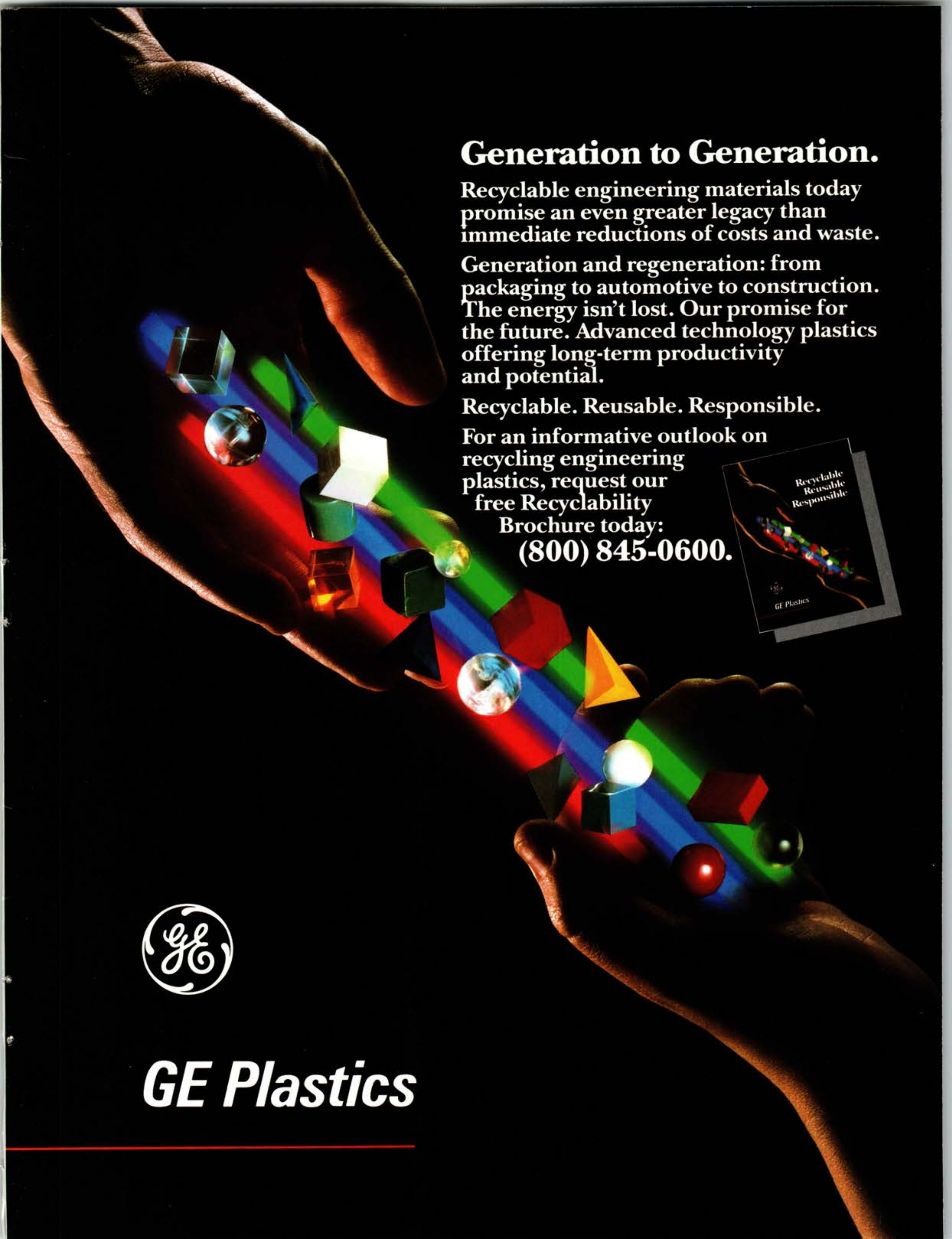
But a more honest label would read: "This brand uses recycled, post-consumer paper waste. However, this is an energy- and garbage-intensive product. Limit your use." Many PT jobs can easily be done by sponges and cloths.

Ozone-Safe Aerosols

Chlorofluorocarbons (CFCs), gases linked to ozone depletion in the upper atmosphere, have been banned from all but a few aerosol products since the mid 1970s. Products such as Arrid Extra Dry spray antiperspirant and White Rain mousse have eliminated CFCs, which is why they tout their "ozone friendliness." What the labels don't tell us is that the replacement propellants, volatile organics such as propane and butane, contribute to smog, and may ignite after disposal. Reformulating the aerosol isn't the answer. A better solution is to eliminate the aerosol deodorant altogether, replacing it with roll-on, solid, or cream — or plain old soap and water.

So you see, many green products are not so much "good for the environment" as they are "less bad given that you will continue your habit of using the product."

That may be good enough for starters, but don't get bamboozled by the marketing.



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GE Plastics

What's happening: Scientists get native fungi to "eat" the selenium. Watering, rototilling (for aeration), and adding orange peels (for carbon) speed the natural process.

TOP AND INSET: WILLIAM T. FRANKENBERGER; OTHERS: GARY R. ZAHM, COURTESY USFWS

Fungus and Orange Peels

At the Kesterson Reservoir in California's San Joaquin Valley, in 1983, scientists discovered scores of dead birds and deformed embryos in marshland nesting sites. Cause: ingestion of selenium, a naturally occurring mineral that had concentrated to quite *un*natural levels in the reservoir. This enraged environmentalists (they dubbed the site "the Three Mile Island of irrigated agriculture") and led the federal Bureau of Reclamation to bury 600 acres of the problem under 1.1 million cubic yards of dirt at a cost of $6.5 million. That didn't get rid of the selenium, nor did it address 21 other selenium-rich agricultural drainwater ponds on private farmland in the southern Valley. But it did kill half of the man-made reservoir, which borders the Kesterson National Wildlife Refuge.

What was: Kesterson Reservoir in 1981 typified marshland in the San Joaquin Valley.

The selenium buildup came from irrigation-water runoff from the intensive agriculture in the Valley. That water, which emptied into wetlands like the Kesterson Reservoir after moving 85 miles through canals built by the Bureau of Reclamation, was contaminated with selenium leached from the soil. The reservoir's drainage ponds lack an outlet, so the selenium concentrated in the soil and water, and moved up the food chain. (Some scientists see the leaching as part of the process of desertification from the use of marginal lands for agriculture.)

Partial restoration of the land may be possible through bioremediation — remedy by natural, biological means. Dr. William T. Frankenberger at the University of California-Riverside has found that three species of native fungi can gobble elevated levels of selenium. The process is called *volatilization* (the fungus expels the selenium as harmless dimethylselenide gas). At test plots in Kesterson, the fungi have eaten their way through better than two-thirds of the selenium in two years. The cleanup proceeds cautiously, however, because tests show that the fungi's appetite for selenium slows after an initial period of quick dissipation. Dr. Frankenberger predicts that the fungi could take as long as a decade to reduce the highest concentrations (up to 700 ppm) to safe levels (about 4 ppm).

What is: Selenium scare led the federal Bureau of Reclamation to bury the problem. It didn't work.

— *Bill Breen*